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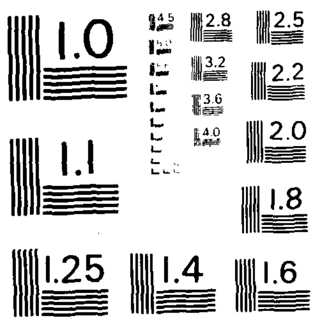

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

AGARDograph No.276

A SURVEY OF BIODYNAMIC TEST DEVICES AND METHODS

by

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PREFACE

The growth spurt characterizing biomedical research in the early sixties, associated with the rapid development of the field of aerospace medicine, resulted in the appearance of a mass of experimental data and theory, requiring organization. In an attempt to give structure and direction to this newly expanding field of investigation, the Biodynamics Committee of the Aerospace Medical Panel of AGARD/NATO began to issue a series of monographs "covering the generally accepted basic information in the fields of prolonged radial and linear acceleration". (Gell, C.F. & Jones, W.L., 1971).

The first "Comparative Table of Acceleration Terminology" was compiled and promulgated by the Biodynamics Committee in 1962 and endorsed by the Aerospace Medical Panel of AGARD, the Aerospace Medical Association and the National Aeronautics and Space Administration. A revision appeared in 1965 and was widely distributed as part of "Principles of Biodynamics", AGARDograph No.150, 1971, a publication covering the physics, physiology and tolerance limits of acceleration forces.

Subsequently a working group was established in 1972, under the auspices of the AGARD Aerospace Medical Panel, to consider standardization of impact testing. A publication titled "A Catalogue of Current Impact Devices" (D.H.Glaister, editor, AGARD Report No.658, 1977) was prepared. It was a comparative presentation of the 42 then-operational or proposed impact test facilities, and summarized the features of each device based on data submitted via questionnaires sent to all known research laboratories.

The Biodynamics Sub-Committee has considered it advantageous to update the "Catalogue" regularly. During the tenure of a University Resident Research Fellowship sponsored by the Air Force Office of Scientific Research, on assignment in the Division of Biodynamics and Bioengineering, Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, the author prepared this survey and catalog. He would like to gratefully acknowledge the support and co-operation of Dr Henning von Gierke, Division Director, and Dr Leon Kazarian, Chief of the Biodynamic Effects Branch, and their associates, for technical support and advice. He is particularly appreciative of the efforts of TSgt. W.R.Johnson and Ms. Suzanne D.Smith-Lagnese in the development of the computer storage and retrieval programs for the impact device data base. The timely and professional preparation of this catalog was accomplished through the very skilful secretarial and editorial services of Ms. Lila Dorn, Ms. Phyllis Reames and Mrs Katherine Bohannan.

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INTRODUCTION

The effort to update the catalog of current impact devices was initiated by corresponding with all facilities listed in the first edition and attempting to verify the name of the current manager or director and their mailing address. A data form was generated, and, as verified names and addresses were received, was sent with an explanatory letter to each. In most cases, data sheets were returned in short order, but second and third mail requests, and in some instances telephone follow-ups, were necessary to achieve returns. Additional facilities were located through personal contact with those responsible for some test devices.

Several new devices were identified that have been built since the last compilation, but in some cases the organization managers indicated that they did not wish to be included. In an effort to increase the data base, announcements were placed in "Aviation Space and Environmental Medicine" inviting participation. No additional laboratories were identified by this mechanism. Several facilities included in the first edition have become non-operational, or were not included in this compilation because of the failure to receive a reply from their supervisory personnel. This resulted in a total of 45 test facilities which form the data base for this revised catalog, representing a slight increase over the originally described 42.

Although all original descriptive and performance data are reported, summary tables have been generated for the benefit and use of technical managers interested in comparing the features and capabilities of the various facilities. These tables are introduced by a master list of all facilities (Table 2) within which the various research centers are listed alphabetically by country and then within countries by appropriate smaller geographic units. Each test instrument is assigned its own identification number (ID#) within this format. Further descriptive summary tables use only this identification number as the instrument entry. It is, therefore, necessary to refer to Table 2 for specific ID numbers before referring to the data base presented in the following tables. The data given represents all input received as of April, 1983. The various facility directors were also asked to report their research goals for the next five years. Their replies can be considered to represent three general areas of effort: human tolerance testing, the development of human analogs, and vehicle hardware and component evaluation. These topics are discussed in a later section.

THE IMPACT FACILITIES DATA BASE

Survey responses are summarized in seven tables arranged to compare design characteristics and performance capabilities. The specific data sheets from which these summaries were generated are presented in a following section. When necessary, units have been converted to SI for comparison purposes in all tables. Individual data sheets reproduce the units as originally reported. Table 2 is an index list of all the facilities and can be used to cross reference the specific data sheet to the facility, as listed in any of the summary tables, using the identification number (ID#) assigned.

Table 3 summarizes the principles of operation and pulse shaping employed, the orientation of the test instrument (horizontal or vertical), man-rating status, physical dimensions and maximum payload. Some managers emphasize the similarity between the deceleration curve produced on impact and the acceleration curve produced by a Hyge apparatus. The operational details of this type of instrument were originally described in the first edition of this catalog, and the number of facilities using, or planning construction of such a test device attests to its popularity. In some cases an organization would identify this form of accelerator as an "impact decelerator" or "reverse impact decelerator" (e.g. MIRA ID# 23). For purposes of this report all instruments of the Hyge type have been considered as impact accelerators.

The most popular instruments are horizontal impact decelerators. Twenty-three of the described 45 facilities utilize this mode of testing. Since this orientation directly simulates the condition of a barrier crash for most civilian vehicle situations, this is not unexpected. Acceleration is accomplished by a variety of methods but 30% (7 of 23) utilize a stretched elastic cord (bungee) to achieve initial velocity. The reliability and reproducibility of this acceleration mode is considered in separate facility descriptions (Giles, 1971) and appears popular because of low construction cost and ease of repetitive testing. A variety of other acceleration mechanisms including solid rocket propulsion, electric and gasoline powered winches, falling weights and pneumatic systems are also in use. The propulsion method seems less critical than the assurance that a period of sustained, controlled velocity precedes impact. This usually involves a "coast" period following the initial acceleration, with and without velocity controlled "trimming," by on-board brakes.

Deceleration impact pulse shaping is accomplished by a variety of methods. Simple barrier crashes into a large mass, simulating the most direct effects of horizontal impact, represent 22% of the reported methods (5 of 23). The use of a flat metal strip of specified physical characteristics adds a degree of control to the pulse shaping process. Deformation of the metal between rollers by a spike fitted to the front of the sled is a function of the impacting mass initial velocity and material properties of the strip employed in a given test. Storage of the deformed strip provides a permanent record of the impact conditions for each test. A variation of the deformable metal strip involves plastic tubes engaging pins on the sled. A greater degree of control is accomplished by utilizing direct impact into pneumatic or hydraulic pistons, or into stretched steel cables attached to hydraulic pistons. The versatility of the fully programmable impact target allows for a greater variety of controlled pulses to be developed (see Table 5), though in practice only a few may actually be used in accord with testing standards.

Vertical impact decelerators are less common than the horizontal orientation, but have the advantage of more directly producing G_z forces without the necessity of reorientation of the test subject. Many

of these devices are used in ejection studies on the premise that the $+G_z$ pulse produced can be made identical to the $+G_z$ pulse experienced during an ejection. However, the force contributed by the weight of the test vehicle and subject, acting in a $-G_z$ direction at the moment of impact, introduces rebound phenomena that have anatomical and physiological effects differing from those of a pure $+G_z$ pulse. The vertical impact decelerator configuration most closely simulates a ground landing impact and can profitably be used for research on human tolerance and crashworthiness of system components in such environments.

The ability to generate a large acceleration pulse over a short stroke distance has made the Hyge type of hydraulic activator a popular research instrument. Reasonably short stroke and "coasting" distances also allow the test area to be completely enclosed for optimum environmental control and data collection. These instruments are thus the most popular horizontal impact accelerators in current use. Since the acceleration pulse can be delivered at a controlled time with such instruments, it is possible tc position precisely the test subject and recording instrumentation for accurate simulation of any impact configuration, prior to delivering the pulse. The problems associated with test subject movement during the "coast" period involved in deceleration testing are thus eliminated. These advantages, however, can be expensive to acquire. The simpler bungee cord actuated horizontal decelerators have thus remained popular even though the positioning problem exists. With only two exceptions (ID# 1,35), the impact accelerators of the Hyge type are dedicated instruments and not readily available for commercial contract work.

The final test configuration in use involve vertical impact accelerators. These instruments represent the least common test mode, even though they are capable of reproducing the $+G_z$ forces associated with aircrewmember ejection directly, with the added advantage of precise pre-positioning. The safety problems associated with braking vertical motion within a reasonable distance, limits these instruments to relatively small acceleration forces. Small units are used for component testing, experimental validation studies prior to larger instrument testing, and studies with small to medium size, nonhuman primates. Large ejection towers are used for human testing.

REPRODUCIBILITY OF IMPACT TEST DATA

A. Repeatability

Many investigators have expressed concern that, as human testing proceeds, the input pulse used may approach or accidently exceed an injury threshold. Accordingly, some attention was drawn to the importance of the reproducibility of specific acceleration or deceleration profiles (von Gierke, 1971). An estimate has been presented, subject to other variables, such as duration, onset times, total velocity change, etc., that these instruments operate with 3 to 5% variability (Kleinhanss, 1971). In an effort to define further the reproducibility of the data generated at the included facilities, each respondent was asked to report the repeatability of peak acceleration (G) and peak velocity for their test instruments. This data is presented in Table 6. Repeatability is defined as deviation from a programmed test value under idealized test conditions for multiple tests. Although not clearly defined in the questionnaire replys, the values presented are assumed to be one standard deviation of a normal distribution of test output data for repeated tests. Some of the replys listed repeatability as relative percentage of the programmed value, assuming the latter to be 100% (i.e. 95% reported was assumed to be 5% of the adopted definition). An estimate of average repeatability was then made and the values for accelerators were compared with those for decelerators. Peak acceleration repeatability averaged $\pm$2.12% for accelerators (N=11) and $\pm$4.21% for decelerators (N=22). Peak velocity repeatability averages were $\pm$2.01% and $\pm$2.70% respectively.

This data indicates a better repeatability is operationally possible, with respect to peak acceleration, when using an accelerator mode, even though the average peak velocity repeatability for the two test configurations, as reported, are essentially the same. When only accelerators of the Hyge type (N=10) are considered, peak acceleration repeatability is further improved to $\pm$1.38. It is thus prudent to perform human testing, close to known tolerance limits, with instruments capable of this degree of repeatability.

B. The Mass Ratio Problem

The inertial reaction of a test object influences the acceleration of the test carriage. This is evident as an effect on the input waveform of the accelerating device. This reaction adversely affects control and repeatability. Designing a test apparatus with very high force producing capability, and a much heavier test carriage will improve the operational acceleration repeatability. The inertial reaction of the test object is then a lower proportion of the total force, and control is improved. Chandler (1971) recommended a mass ratio of carriage to test object of 10 to 1 or more, in order to achieve reasonable impact acceleration control.

In practice it is apparently difficult to meet or even approach this proposed condition. Of the 46 test configurations presented in Table 4, only four exceed a mass ratio of 3 and of these only two exceed a value of 7. It is likely that the payload values reported have seat restraint systems or other fixed components used to position a test subject included in the "payload" mass value. Under more specific and limiting definitions, this mass might more properly be considered part of the "sled" mass, thus improving significantly the mass ratio factor for a given operational condition. Since in most test situations the subject is the relevant payload, these other ancillary masses, if properly attached to the transporting mechanism, should be added to the sled weight and deducted from the payload so as greatly to improve the mass ratio value. A standard human male weight of 70kg was therefore used to recalculate the mass ratios of all devices that could be identified as "man-rated." The recalculated values are presented in Table 4. The corrected data indicate that eight devices can be operated with mass ratio values of 10 or more and that another six can achieve values between 5 and 10.

A significant improvement in the reliability and accuracy of test data was originally accomplished by enclosing test facilities, and thereby reducing the effects of temperature on components. It may be difficult to achieve further improvements in reliability, except by careful procedure.

INSTRUMENTATION, DATA ACQUISITION AND REDUCTION

Tables 7 and 8 present details of the instrumentation capability at each test site. The number of data channels and methods of on-line recording are indicated together with the frequency response of the highest class reported, in Table 7. Reference to "Instrumentation for Impact Tests," (Society of Automotive Engineers, J211a) allows evaluation of typical test capability from this data. Recommended applications for the various frequency classes of data channel have been proposed (Table 1) and data filtering techniques to implement these recommendations are in common use (Reichert & Landolt, 1981).

Table 1. EXAMPLES OF CHANNEL CLASSES (Frequency)
(SAE J211a)

Typical Test Measurement	Channel Class Hz
Vehicle structural accelerations for use in:	
Collision simulation	60
Component analysis	600
Integration for velocity or displacement	180
Belt restraint loads	60
Occupant:	
Head acceleration	1000
Chest acceleration	180
Sled acceleration	60

Table 8 presents the accelerometer inventory at each facility, the dynamic and frequency range of these instruments, and the maximum number available for test purposes. Recent refinements of J211a as incorporated in "Road vehicles - Techniques of measurement in impact tests - Instrumentation" (ISO 6487-1980(E)), specify that the amplitude class (the upper limit of the measurement range) as well as the frequency class must be given to define a data channel. Further recommendations refer to recording and data processing standards, and transducer mounting specifications as a guide to meeting the requirements of this International Standard.

Subcommittee 4 on Human Exposure to Mechanical Vibration and Shock of the International Standards Organization (ISO), Technical Committee 108 on Shock and Vibration (ISO/TC108/SC4) is working on a draft standard* to provide guidance on human impact testing, the characterization of input and output data, test subject selection and data interpretation. Additional documents aimed at partial standardization of human impact testing methods and instrumentation are planned.

Direct transcription of data channels by magnetic or paper recording allows for later processing by dedicated computors. Data processing capability generally includes real-time evaluation as well as statistically validated review. Most facilities include high speed film capability. A film digitizing program greatly increases the usefulness of such data, and routinely fiducial indicators are included in all tests for this purpose.

The physical arrangement of a test site should also accommodate medical monitoring and physiological recording if human subjects are involved. All weather enclosures for the various elements of an integrated test site may establish a building expense that represents the major cost of the total facility. Such environmental protection is however, vital to the repeatability criteria stated above.

Several representative test installations have been described in "Open Forum on Facilities for Impact Studies" (AGARD Conference Proceedings No. 88 on Linear Acceleration of Impact Type, pp. B1-1 to B5-7, 1971). Other site details are presented in:

Anon 1980, Crashanlage, Bayerische Motoren Werke, A.G., Munich.

Huber, G. 1974. Eine Anlage fur Fahrzeug - Unfallversuche mit Linearmotor als Antrieb. Automobiltechnische Z. 76:48-52.

Kallieris, D. 1974. Eine Fallgewichtsbeschleunigungsanlage zur Simulation von Aufprallunfallen - Prinzip und Arbeitsweise. Z. Rechtsmedizin 74:25-30.

Prevost, T. G. 1976. An Automotive Crash Test Facility 1976. Environmental Activities Publication A-3398. General Motors Corp. Warren, Michigan 48090.

Reichert, J. K. & Landolt, J. P. 1980. Impact Studies Facility. DCIEM Tech. Con. 80-C-03. Defence and Civil Institute of Environmental Medicine, Downsview, Ontario, Canada.

*ISO/TC108/SC4, Working Group 4, Secretariat: Acoustical Society of America, Standards Secretariat, 335 East 45th St., New York, NY 10017

Shaffer, J. T. 1976. The Impulse Accelerator. An Impact Sled Facility for Human Research and Safety Systems Testing. AFAMRL-TR-76-8. Aerospace Medical Research Lab., WPAFB, OH 45433.

Sievert, W. 1980. Die Aufprall - Versuchsanlage der Bundersanstalt fur Strassenwesen. Automobiltechnische Z. 82:507-511.

RESEARCH GOALS AND METHODS

The ultimate goal of biodynamic impact testing is to establish human tolerance levels in terms of injury/fatality probabilities. A complete description of all factors that contribute to such an evaluation is still beyond the state-of-the-art in biomechanics (SAE J885 APR 80). Several complications prevent the direct correlation of injury to impact force. Individual tolerance levels are not precise, quantitative values, and various individuals show large differences in their response to injury. Research to date also indicates that different mechanisms of injury and resultant symptoms occur for each impact direction. (von Gierke and Brinkley, 1975).

Semi-quantitative injury scales have been generated by different workers examining either the whole body or segments (SAE J885 APR 80 for bibliography). However, extensive data collection is required to begin to assess the influence of age, size, sex and weight on statistically valid populations. Each research facility tends to identify a particular subset of this matrix for study in accord with its operational mission and capabilities (Kazarian and Graves, 1977).

Human tolerance levels are investigated by indirect methods such as exposing volunteers to impact forces below their injury levels, and through the use of cadavers or anesthetized animals. Though each test subject offers some distinct advantage, there are inherent problems in the direct applicability of the data. Volunteers are useful in determining the effects of muscle tone and pre-bracing on the biodynamic response to impact. Since they cannot be tested into the injury range, volunteers can only provide information about the upper boundary of the tolerance level. Furthermore, volunteers are usually young, healthy, males who tend to have a higher pain threshold than the general population. Cadavers can be employed when potentially injurious testing is performed. It is assumed that geometric and structural characteristics will be the same as those of volunteers. However the age and the preparation of the cadaver, and the time since death can affect the material properties of tissues and thus the failure mechanisms of various organ systems. Animal testing is usually performed to study the injury mode resulting from severe impact. However, the results of animal tests cannot always be adequately scaled to quantitatively predict human tolerance limits due to differences in size, shape and other structural and physiological parameters.

Data from testing strategies using volunteers, cadavers, or animals have been used to develop human surrogates. These may take the form of instrumented dummies or computor manipulated mathematical models. These analogs must be sufficiently human-like so that their responses will be close to those of the individuals they model. Continued refinement of instrumented dummies to achieve an anthropodynamic surrogate is recognized as an immediate objective by most research teams. The kinematic response of the dummy is determined by its body dimensions, mass distributions and joint characteristics (articulation and motion resistance). Deformability, or the response of body regions under dynamic loading, will determine the accelerations and deflections of each body segment during impact. Deformability properties can be major factors effecting the overall realism of the test and thus the value of the data generated. In some cases, specific research groups, depending upon whether their interests are primarily concerned with land or air/space environments, will specially fabricate a segment, or modify a "standard" dummy. Comparison of test data then becomes more difficult.

Mathematical models describing the dynamic response of the body, allow analysis of the complex waveforms that more closely approximate real impact situations than can be simulated with uni-directional impact testing. Several models have been developed that range in complexity from descriptions of single tissues through subsystems such as the head and neck or the spine, to total body analogs. Refinement and validation of these models and improvement of instrumented anthropodynamic dummies can lead to a more complete analysis of impact protection requirements (AGARD-CP-253).

Seat restraint systems, force attenuation systems and impact surface evaluation are of concern in determining the crashworthiness of vehicles. Animals, particularly non-human primates, as well as dummy surrogates are of value in testing these components to failure. Animal tests are especially valuable in suggesting injury mechanisms that can occur under specified occupant-vehicle configurations. Comparison of test results with clinical information from field accidents often allows valid interpretation and reconstruction of the injury mode, even though direct scaling from animal data is not possible. (Kazarian and von Gierke, 1978).

TABLE 2
IMPACT TEST FACILITIES

ID#	NAME	ADDRESS
1	DCIEM IMPACT STUDIES FACILITY	DOWNSVIEW, ONT., M3M 3B9, CAN.
2	CENTRE D'ESSAIS EN VOL	91220 BRETIGNY, AIR, FR.
3	ONSER	69500 BRON, FR.
4	CENTRE D'ESSAIS EN VOL	33630 CAZAUX, FR.
5	CENTRE TECHNIQUE RENAULT	F-91 LARDY, FR.
6	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
7	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
8	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
9	LAB. DE L'U.T.A.C.	91310 MONTLHERY, FR.
10	INST. FAHRZEUGTECHNIK	D-1000 BERLIN, W. GER.
11	BATTELLE-INSTITUTE. V.	D-6000 FRANKFURT, W. GER.
12	KLINIKUM DER UNIV. HEIDELBERG	1.6900 HEIDELBERG, W. GER.
13	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
14	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
15	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
16	DAIMLER-BENZ AG	SINDELFINGEN, W. GER.
17	FIAT-CENTRO SICUREZZA	ORBASSANO (TORINO)-ITALIA
18	RAF, INST. AVIATION MED.	FARNBOROUGH, HANTS, UK.
19	ROYAL AIRCRAFT ESTABLISHMENT	FARNBOROUGH, HANTS, UK.
20	ROAD SAFETY ENGINEER LAB, MIDDLESEX POLY.	HENDON, NW4 4BT., UK.
21	DEPT. OF HUMAN SCI., UNIV. TECH.	LOUGHBOROUGH, LE11 3TU, UK.
22	MOTOR INDUSTRY RES. ASSOC.	NUNEATON, WARKS, CV10 OTU, UK.
23	MOTOR INDUSTRY RES. ASSOC.	NUNEATON, WARKS, CV10 OTU, UK.
24	SIMULA INC.	TEMPE, ARIZONA 85282
25	SIMULA INC.	TEMPE, ARIZONA 85282
26	S.R.I. INTERNATIONAL	MENLO PARK, CA. 94025
27	NAVAL BIODYN. LAB	NEW ORLEANS, LA. 70189
28	NAVAL BIODYN. LAB	NEW ORLEANS, LA. 70189
29	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
30	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
31	BIOENGIN. CENTER, WAYNE STATE U.	DETROIT, MI. 48202
32	DYNAMIC TEST FACILITY, FAA	ATLANTIC CITY, NJ 08405
33	CALSPAN CORPORATION	BUFFALO, NY. 14225
34	INLAND DIV. GENERAL MOTORS	DAYTON, OH. 45401
35	TRANSPORT. RES. CTR. OF OH.	EAST LIBERTY, OH.
36	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
37	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
38	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
39	AF AEROSPACE MEDICAL RESERACH LAB	WRIGHT-PATTERSON AFB, OH 45433
40	AF AEROSPACE MEDICAL RESEARCH LAB	WRIGHT-PATTERSON AFB, OH 45433
41	PROTECT. SURVIVAL LAB., FAA	OKLAHOMA CITY, OK. 73125
42	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
43	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
44	NAVAL AIR DEVELOPMENT CENTER	WARMINSTER, PA. 18974
45	SOUTHWEST RES. INST.	SAN ANTONIO, TX. 78284

TABLE 3
FACILITY DESCRIPTION

ID#	PRINCIPLE OF OPERATION AND/OR PULSE SHAPING	MAN* RATED	TRACK LENGTH/ TOWER HEIGHT(m)	PAYLOAD WT (Kg) SLED 1	SLED 2	SLED 3
	I. HORIZONTAL IMPACT DECELERATORS					
3	Deformable Plastic Tube	(1)	20.0	300.0		
4	Solid Fuel Rocket	N	600.0	1000.0		
5	Barrier Crash	(1)	(1)	10000.0	10000.0	
6	Elastic Cord/Polyurethane Tube	N	6.0	200.0	700.0	
7	Elastic Cord/Polyurethane Tube	N	20.0	200.0	700.0	
8	Winch	N	400.0	200.0	700.0	
10	Drop Weight/Metal Strip	(1)	30.0	500.0		
11	Bungee/Metal Strip	Y	11.0	300.0		
12	Drop Weight/Metal Strip	(1)	24.0	611.4		
13	Linear Induction Motor	(1)	65.0	10000.0		
15	Bungee/Barrier Crash	(1)	(1)	670.0		
16	Bungee/Barrier Crash	(1)	(1)	250.0		
17	Electric Drive/Barrier Crash	(1)	420.0	20000.0		
18	Bungee/Steel Cable	Y	46.0	250.0		
22	Linear Induction Motor	(1)	51.8	4536.0		
26	Pneumatic Piston	(2)	3.0	36.3		
29	Pneumatic	Y	40.0	1121.0		
30	Pneumatic	Y	20.0	122.3		
32	Pneumatic	N	91.0	2860.0		
34	Pneumatic	N	11.0	861.8		
39	Hydraulic Piston	Y	76.2	636.0	909.0	
41	Deformable Metal Wire	N	46.0	1000.0		
45	Bungee/Pneumatic Rebound	Y	11.9	1814.4		
	II. VERTICAL IMPACT DECELERATORS					
9	Gravity	N	33.0	200.0	700.0	
21	Honeycomb/Tear Webbing	(3)	6.0	120.0		
25	Gravity	N	20.0	(1)		
31	Pneumatic	N	36.5	91.7		
36	Gravity/Hydraulic Piston	Y	15.2	909.0		
38	Gravity/Honeycomb	N	14.9	45.5		
44	Metal Brakes	Y	36.6	317.5		
	III. HORIZONTAL IMPACT ACCELERATORS					
1	Hygee 12	(3)	37.0	2268.0		
14	Hygee 12	(1)	65.0	2500.0		
20	Rubber Cord	N	33.0	800.0		
23	Hygee 12	N	28.0	1818.0		
24	Gravity	N	45.0	(1)		
27	Hygee 12	Y	213.0	2268.0	181.4	341.4
33	Hygee 12	Y	27.0	1587.6		
35	Hygee 24	N	29.0	4536.0		
40	Hygee 24	Y	76.0	4550.0	1450.0	
42	Hygee 12	Y	30.5	1361.0		
	IV. VERTICAL IMPACT ACCELERATORS					
2	Solid Fuel Rocket	N	33.0	100.0		
19	Ejection Catapult	(3)	47.2	(1)		
28	Hygee 6	N	12.2	227.2		
37	Hygee 6	N	6.1	57.0		
43	Ballistic	Y	45.7	362.9		

NOTES

(1) Information Not Supplied
(2) Model Structures Tested Only
(3) Not U.S. "Man Rated", but safe for use in human studies

*"Man-rated" means use of facility with human test subjects after satisfying formal or informal local or national safety requirements.

Y=Yes
N=No

TABLE 4
SLED CHARACTERISTICS

ID#	SLED WT. Kg	PAYLOAD WT. Kg	MASS RATIO (1)
1	725.76	2268.00*	0.32 (10.37)
2	75.00	100.00	0.75
3	500.00	300.00	1.67
4	1500.00	1000.00	1.50
5	15000.00	10000.00	1.50
5	15000.00	10000.00	1.50
6	400.00	200.00	2.00
6	800.00	700.00	1.14
7	400.00	200.00	2.00
7	800.00	700.00	1.14
8	400.00	200.00	2.00
8	800.00	700.00	1.14
9	400.00	200.00	2.00
9	800.00	700.00	1.14
10	1000.00	500.00	2.00
11	140.00	300.00*	0.47 (2.00)
12	387.22	611.40	0.63
13	(2)	10000.00	-
14	1000.00	2500.00	0.40
15	460.00	670.00	0.69
16	180.00	250.00	0.72
17	(2)	20000.00	-
18	386.00	250.00*	1.54 (5.51)
19	(2)	(2)	-
20	485.00	800.00	0.61
21	200.00	120.00*	1.67 (2.86)
22	(2)	4536.00	-
23	1090.00	1818.00	0.60
24	(2)	(2)	-
25	(2)	(2)	-
26	9.07	36.29	0.25
27	907.00	2268.00*	0.40 (12.96)
27	265.00	181.40*	1.46 (3.79)
27	165.00	341.37*	0.48 (2.36)
28	112.00	227.24	0.49
29	599.00	1121.00*	0.53 (8.56)
30	591.00	122.30*	4.83 (8.44)
31	102.00	91.70	1.11
32	(2)	2860.00	-
33	920.80	1587.60*	0.58 (13.15)
34	272.20	861.80	0.32
35	1633.00	4536.00	0.36
36	909.00	909.00*	1.00 (13.00)
37	40.00	57.00	0.70
38	277.00	45.50	6.09
39	1182.00	636.00*	1.86 (16.89)
39	909.00	909.00*	1.00 (13.00)
40	818.00	4550.00*	0.18 (11.69)
40	364.00	1450.00*	0.25 (5.20)
41	408.00	1000.00	0.41
42	907.00	1361.00*	0.67 (12.96)
43	68.00	362.90*	0.19 (0.97)
44	589.70	317.50*	1.86 (8.42)
45	385.60	1814.40*	0.21 (5.51)

(1) Sled Wt/Payload Wt, (Chandler, R.F. 1971. Discussion on Facilities for Impact studies. AGARD Conference Proceedings No. 88, p. xxxv.)

(2) Information not supplied.

*Man-rated, 70kg used as payload to recalculate mass ratio values, (in parentheses).

TABLE 5
AVAILABLE WAVEFORMS

ID#	WAVEFORM	RANGE ACCEL G	DURATION ms(1)
1	1/2 SINE	0.00 - 50.00	97.00
1	OTHER	PIN DESIGN CAPABILITY FOR VARIOUS WAVEFORMS	
2	SAWTOOTH	1.00 - 40.00	(2)
3	RECTANGLE	-	-
4	TRAPEZOIDAL	-	-
5	SINE	NEARLY ANY SHAPE IS POSSIBLE	-
6	SINE	-	-
7	SINE	-	-
8	SINE	-	-
9	SINE	-	-
10	TRAPEZOIDAL	5.00 - 40.00	-
10	RECTANGLE	5.00 - 40.00	-
11	TRAPEZOIDAL	- 30.00	80.00
12	TRAPEZOIDAL	DEPENDENT ON SLED VELOCITY AND DECELERATION	
13	-	DEPENDS ON IMPACT SURFACE AND VEHICLE DYNAMICS	
14	1/2 SINE	-	-
14	TRIANGLE	-	-
14	TRAPEZOIDAL	-	-
14	RECTANGLE	-	-
14	OTHER	(2)	-
15	1/2 SINE	-	-
15	TRIANGLE	-	-
15	TRAPEZOIDAL	-	-
15	RECTANGLE	-	-
15	OTHER	-	-
16	1/2 SINE	-	-
16	TRIANGLE	-	-
16	TRAPEZOIDAL	-	-
16	RECTANGLE	-	-
16	OTHER	-	-
17	-	-	-
18	1/2 SINE	2.00 - 50.00	200.00
19	TRAPEZOIDAL	-	-
20	1/2 SINE	20.00 - 32.00	100.00
20	TRAPEZOIDAL	12.00 - 14.00	FUNCTION OF SLED VELOCITY
21	TRAPEZOIDAL	- 10.20	200.00
22	-	DEPENDS ON VEHICLE TYPE AND BARRIER	
23	1/2 SINE	- 50.00	130.00
23	RECTANGLE	- 50.00	130.00
23	SAWTOOTH	- 50.00	130.00
24	1/2 SINE	-	-
24	TRIANGLE	-	-
24	TRAPEZOIDAL	-	-
25	1/2 SINE	-	-
25	TRIANGLE	-	-
25	TRAPEZOIDAL	-	-
26	RECTANGLE	10.00 - 300.00	-
27	SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	1/2 SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	TRAPEZOIDAL	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	SAWTOOTH	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
27	OTHER	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	1/2 SINE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	TRIANGLE	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	TRAPEZOIDAL	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	SAWTOOTH	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
28	OTHER	DEPENDENT UPON SLED-WEIGHT AND ACCELERATION	
29	1/2 SINE	5.00 - 50.00	300.00
29	TRIANGLE	5.00 - 50.00	300.00
29	TRAPEZOIDAL	5.00 - 50.00	300.00
29	RECTANGLE	5.00 - 50.00	300.00
29	SAWTOOTH	5.00 - 50.00	300.00
30	1/2 SINE	5.00 - 50.00	300.00
30	TRIANGLE	5.00 - 50.00	300.00
30	TRAPEZOIDAL	5.00 - 50.00	300.00
30	RECTANGLE	5.00 - 50.00	300.00
30	SAWTOOTH	5.00 - 50.00	300.00

TABLE 5 CONTINUED
AVAILABLE WAVEFORMS

ID#	WAVEFORM	RANGE ACCEL G	DURATION ms(1)
31	1/2 SINE	5.00 - 50.00	300.00
31	TRIANGLE	5.00 - 50.00	300.00
31	TRAPEZOIDAL	5.00 - 50.00	300.00
31	RECTANGLE	5.00 - 50.00	300.00
31	SAWTOOTH	5.00 - 50.00	300.00
32	1/2 SINE	3.00 - 50.00	120.00
33	TRIANGLE	55.00 MIN. (2)	50.00
33	TRAPEZOIDAL	5.00 - 40.00	150.00
33	SAWTOOTH	55.00 MIN. (2)	50.00
33	OTHER	70.00 MIN. (2)	150.00
34	OTHER	PROGRAMMABLE TO SIMULATE GIVEN VEHICLE	
35	1/2 SINE	2.00 - 100.00	100.00
35	TRAPEZOIDAL	5.00 - 50.00	130.00
35	OTHER	0.00 - 24.00	100.00
36	1/2 SINE	-	-
36	TRIANGLE	-	-
37	1/2 SINE	-	-
37	TRAPEZOIDAL	-	-
37	RECTANGLE	-	-
37	SAWTOOTH	-	-
38	RECTANGLE	10.00 - 600.00	24.00
39	1/2 SINE	- 100.00	67.00
39	TRIANGLE	- 100.00	76.00
39	TRAPEZOIDAL	- 100.00	49.00
39	SAWTOOTH	- 100.00	93.00
39	OTHER	- 100.00	-
40	1/2 SINE	1.00 - 150.00	55.00
40	TRIANGLE	1.00 - 150.00	70.00
40	TRAPEZOIDAL	1.00 - 150.00	50.00
40	RECTANGLE	1.00 - 150.00	35.00
40	SAWTOOTH	1.00 - 150.00	70.00
40	OTHER	1.00 - 150.00	-
41	1/2 SINE	DEPENDENT UPON VELOCITY AND DECELERATION	
41	TRIANGLE	DEPENDENT UPON VELOCITY AND DECELERATION	
41	TRAPEZOIDAL	DEPENDENT UPON VELOCITY AND DECELERATION	
41	SAWTOOTH	DEPENDENT UPON VELOCITY AND DECELERATION	
42	1/2 SINE	- 40.00	100.00
42	TRIANGLE	- 40.00	100.00
42	TRAPEZOIDAL	- 30.00	100.00
42	OTHER	(2)	-
43	TRAPEZOIDAL	4.00 - 30.00	300.00
44	TRIANGLE	-	-
44	TRAPEZOIDAL	-	-
45	SINE	.50 - 60.00	375.00
45	1/2 SINE	.50 - 60.00	375.00
45	TRIANGLE	.50 - 60.00	375.00
45	TRAPEZOIDAL	.50 - 60.00	375.00
45	RECTANGLE	.50 - 60.00	400.00
45	OTHER	-	-

NOTES

(1) IF RANGE REPORTED, MAXIMUM GIVEN
(2) SEE DATA SHEET

TABLE 6

I. PERFORMANCE PARAMETERS (HORIZONTAL)

ID#	ACCELERATION G	JOLT Gs^{-1}	VELOCITY ms^{-1}	STROKE m	REPEATABILITY (PEAK)* G%	VELOCITY %
1	50.00	4000.00	29.50	2.44	2.00	2.00
3	30.00		27.78			2.00
4	60.00	75.00	900.00	150.00	95.00	90.00
5					5.00	1.00
6	100.00		35.56		5.00	1.00
7	100.00		35.56		5.00	1.00
8	100.00		35.56		5.00	1.00
10	1.50		22.35	0.80	5.00	5.00
11	40.00	2500.00	19.50	0.80	5.00	1.00
12	40.00		27.78		97.00	100.00
13			13.90			1.00
14	80.00		36.11		1.00	0.50
15	80.00		36.11		1.00	0.50
16	80.00		36.11		1.00	0.50
17			38.88			
18	50.00	1000.00	15.00	0.90	1.00	0.25
20	50.00		22.22	1.00	5.00	4.00
22	INDETERMINATE	INDETERMINATE	22.35	INDETERMINATE		1.00
23	50.00		27.78	3.00	2.50	2.50
24	50.00		20.00			
26	300.00		30.46	0.91		5.00
27	200.00	50.00	40.00	1.70	1.00	1.00
29	50.00	2500.00	30.00	2.00	5.00	5.00
30	50.00	2500.00	30.00	2.00	5.00	5.00
32	15.00		27.30	91.00		
33	72.00		24.59	2.44	2.50	2.50
34	50.00		17.88	1.37		2.00
35	100.00		44.70	1.83	1.00	1.00
39	100.00	10000.00	38.10	1.42	5.00	3.00
40	150.00	4000.00	51.51	2.56	1.00	1.00
41	50.00	2000.00	20.00	5.50	4.60	0.32
42	50.00		30.50	1.50	2.50	2.50
45	60.00	6000.00	31.29	0.50	2.00	4.00

II. PERFORMANCE PARAMETERS (VERTICAL)

ID#	ACCELERATION G	JOLT Gs^{-1}	VELOCITY ms^{-1}	STROKE m	REPEATABILITY (PEAK)* G%	VELOCITY %
2	30.00	100.00	120.00	25.00		
9	100.00		35.56		5.00	1.00
19	20.00	300.00	20.90			
21	100.00		6.00	1.50	20.00	
25	50.00		20.00			
28	15.00	500.00	14.70	0.68	1.00	1.00
31	25.00	2500.00	20.00	2.00	5.00	5.00
36	80.00	500.00	17.07	1.22	7.50	7.50
37	150.00	3200.00	17.98	0.48	2.00	2.00
38	600.00		14.02		95.00	99.00
43	30.00	3000.00	22.90	1.90	5.00	5.00
44	55.00	1000.00	25.90	1.50	5.00	3.00

*Deviation from a programmed test value under idealized test conditions for multiple tests. See p. 7 for further discussion.

TABLE 7
INSTRUMENTATION DESCRIPTION

ID#	NO. CHANNELS	FREQ CLASS (KHZ)	RECORD. METHOD	TRANS. METHOD
1	69	40.0	FM TAPE CHART, A/D	FLYING LEAD
2	14	1.0	TAPE CHART	FLYING LEAD FM TRANSMISS
3	50	1.0	TAPE CHART	FLYING LEAD FM TRANSMISS
4	IN COMPLIANCE WITH IRIG STANDARDS		TAPE CHART	FLYING LEAD FM TRANSMISS
5	80	1.0	TAPE	FLYING LEAD
6	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
7	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
8	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
9	50	1.0	TAPE, CHART PAPER REC.	FLYING LEAD FM TRANSMISS
10	48	1.0	TAPE, PCM	FLYING LEAD
11	10	1.0	TAPE	FLYING LEAD
12	30		TAPE	FM TRANSMISS
13	75	0.6	CHART	FLYING LEAD
14	75	0.6	TAPE	FLYING LEAD
15	75	0.6	TAPE	FLYING LEAD
16	75	0.6	TAPE	FLYING LEAD
17	96	1.65	TAPE, CHART	FM TRANSMISS
18	14 12	0.2 0.1	TAPE, C.R.O. CHART	FLYING LEAD
19	11	1.0	TAPE	FM TRANSMISS
20	16	1.0	CHART	FLYING LEAD
21	6	0.5	TAPE	FLYING LEAD
22	65	10.0	TAPE PAPER	FLYING LEAD FLYING LEAD
23	28	1.0	TAPE GALVANOMETER	FLYING LEAD
24	26		TAPE, CHART	FLYING LEAD
25	26		TAPE, CHART	FLYING LEAD
26	28		TAPE	FLYING LEAD
27	88	12.0	TAPE, CHART	FLYING LEAD
28	88	12.0	TAPE, CHART	FLYING LEAD
29	73	1.0	TAPE, A/D CHART	FLYING LEAD
30	73	1.0	TAPE, A/D CHART	FLYING LEAD
31	40	1.0	TAPE, A/D CHART	FLYING LEAD
32	IN THE PROCESS OF UPDATING			
33	54	1.0	FM TAPE, DDAS	FLYING LEAD
34	50	1.0	FM TAPE, CHART	FLYING LEAD
35	64	1.0	TAPE, CHART	FLYING LEAD
36	50	10.0	TAPE	FLYING LEAD
37	9	2.0	TAPE	FLYING LEAD
38	30	2.0	TAPE, CHART	FLYING LEAD
39	50	10.0	TAPE, A/D CHART	FLYING LEAD FM TRANSMISS
40	50	10.0	TAPE, CHART DIGITAL	FLYING LEAD FM TRANSMISS
41	42	1.0	TAPE, ANALOG CHART	FLYING LEAD
42	28	1.0	TAPE, CHART	FLYING LEAD
43	25	1.0	TAPE, OSCILL. CHART	FLYING LEAD
44	25	1.0	TAPE CHART	FLYING LEAD
45	28	5.0	ANAL/DIG. REC OSCILLOGRAPH	FLYING LEAD

TABLE 8
ACCELEROMETER DESCRIPTION

ID#	TYPE	DYNAMIC RANGE (G)	FREQ. RANGE (KHZ)	MAX. NUMBER USED SLED	SUBJECT
1	PIEZO RES.	0.00 - 5000.00	0.00 - 2.00	(1)	(1)
2	INDUCTANCE	0.00 - 50.00	-	(2)	9
2	PIEZO RES.	-	-	(2)	9
3	PIEZO RES.	10.00 - 1000.00	-	5	12
4	INDUCTANCE	10.00 - 200.00	-	1	(2)
4	PIEZO ELECT.	-	-	1	(2)
5	(1)	-	-	8	8
6	PIEZO ELECT.	1.00 - 1000.00	-	40	9
6	PIEZO RES.	1.00 - 1000.00	-	40	9
7	PIEZO ELECT.	1.00 - 1000.00	-	40	9
7	PIEZO RES.	1.00 - 1000.00	-	40	9
8	PIEZO ELECT.	1.00 - 1000.00	-	40	9
8	PIEZO RES.	1.00 - 1000.00	-	40	9
9	PIEZO ELECT.	1.00 - 1000.00	-	40	9
9	PIEZO RES.	1.00 - 1000.00	-	40	9
10	ENDEVCO	- 750.00	- 2.00	1	9
10	ENDEVCO	- 2500.00	- 9.00	1	9
11	HOLTINGER	0.00 - 600.00	- 5.00	1	9
12	ENDEVCO 2264	-2000.00 - +2000.00	- 27.00	1	29
13	(1)	-	-	(1)	(1)
14	CEC	- 250.00	- 1.00	2	6
14	ENDEVCO	- 750.00	- 2.00	2	3
15	CEC	- 250.00	- 1.00	2	6
15	ENDEVCO	- 750.00	- 2.00	2	3
16	CEC	- 250.00	- 1.00	2	6
16	ENDEVCO	- 750.00	- 2.00	2	3
17	PIEZO RES.	- 200.00	0.00 - 1.10	50	16
17	PIEZO RES.	- 250.00	0.00 - 2.00	50	16
17	PIEZO RES.	- 750.00	0.00 - 2.00	50	16
18	KYOWA	-50.00 - +50.00	DC - 0.75	1	(2)
19	SMITH ALV 692	-	DC - 1.00	(1)	(1)
20	PIEZO RES.	0.00 - 1800.00	-	2	1
21	PIEZO ELECT	0.00 - 5098.40	0.00 - 20.00	(1)	(1)
22	STRAIN GAUGE	- 750.00	-	(1)	(1)
23	STRAIN GAUGE	0.00 - 750.00	0.00 - 2.00	1	9
24	STRAIN GAUGE	-100.00 - +100.00	- 0.50	3	8
24	PIEZO RES.	-100.00 - +100.00	- 2.00	3	8
25	STRAIN GAUGE	-100.00 - +100.00	- 0.50	3	8
25	PIEZO RES.	-100.00 - +100.00	- 2.00	3	8
26	SEE DATA SHEET	-	-	(1)	(1)
27	PIEZO RES.	0.00 - 500.00	0.00 - 20.00	3	18
28	PIEZO RES.	0.00 - 500.00	0.00 - 20.00	3	18
29	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4	36
29	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4	36
29	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4	36
30	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4	36
30	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4	36
30	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4	36
31	PIEZO RES.	0.00 - 2000.00	0.00 - 1.00	4	36
31	STRAIN GAUGE	0.00 - 200.00	0.00 - 0.50	4	36
31	PIEZO ELECT.	0.00 - 1000.00	0.01 - 40.00	4	36
32	SEE DATA SHEET	-	-	(1)	(1)
32	CEC	-250.00 - +250.00	- 2.00	100	40
33	ENDEVCO	-750.00 - +750.00	-	100	40
33	KISTLER	-100.00 - +100.00	- 1.00	100	40
34	PIEZO RES.	- 750.00	0.00 - 2.00	1	6
35	ENDEV. 7232C	-750.00 - +750.00	0.00 - 2.00	3	61
35	ENDEV. 2260C	-250.00 - +250.00	0.00 - 2.00	3	61
35	ENDEV. 7267C	-750.00 - +750.00	0.00 - 2.00	3	61
35	CEC 4-202	-250.00 - 250.00	0.00 - 2.00	3	61
36	PIEZO RES.	-	-	1	(2)
37	PIEZO RES.	0.00 - 250.00	DC - 2.00	1	(2)
38	PIEZO RES.	0.00 - 250.00	-	21	9
39	PIEZO RES.	- 500.00	0.00 - 3.00	5	12
39	PIEZO ELECT.	- 250.00	0.00 - 3.00	5	12
39	STRAIN GAUGE	- 250.00	0.00 - 0.25	5	12
40	PIEZO RES.	- 250.00	-	6	9
41	STRAIN GAUGE	10.00 - 250.00	0.00 - 1.00	(2)	(2)
42	STRAIN GAUGE	-100.00 - +100.00	- 0.75	2	9
43	STRAIN GAUGE	-100.00 - +100.00	0.00 - 0.75	2	9
44	STRAIN GAUGE	-100.00 - +100.00	0.00 - 0.75	2	9
45	ENDEV 2264	-2000.00 - +2000.00	0.00 - 5.00	2	24
45	ENDEV 7264	-2000.00 - +2000.00	0.00 - 5.00	2	24
45	ENDEV 2260	-250.00 - +250.00	0.00 - 2.00	2	24

(1) INFORMATION NOT SUPPLIED; (2) SEE DATA SHEET

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NATO/AGARD

Impact Test Facility Survey

ID #1

1. Name and Address of Facility — DCIEM IMPACT STUDIES FACILITY
   P.O. BOX 2000
   1133 SHEPPARD AVE. W.
   DOWNSVIEW, ON. M3M 3B9, CANADA

2. Name of Director/Manager — DR. JACK P. LANDOLT

3. Date Facility became operational — OCTOBER 1979

4. Principle of Operation — HYDRAULIC/PNEUMATIC 12-INCH ACTUATOR (BENDIX HYGE)

5. Main Use/Test Type — VEHICLE AND AIRCRAFT SEAT AND BELT TESTS

   a. Man Rated:
      yes____ no____ — PENDING

6. Descriptive Details
   a. Horizontal X
   b. Track Length 37m
   c. Vertical N/A
   d. Tower Height N/A

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	1000 LB		
e.2. Width (max)	4 FT		
e.3. Length (max)	15 FT		

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	5000 LB		
f.2. Width (max)	10 FT		
f.3. Length (max)	12 FT		
f.4. Range of Orientation	360°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50 G	
b. Jolt	4000 G/SEC	
c. Velocity	66 MPH	
d. Stroke	8 FT	

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	UP TO 50 G	97 MILLISEC
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)	PIN DESIGN CAPABILITY FOR VARIOUS WAVEFORMS		

   f. Repeatability
      f.1. Peak G ±2 %
      f.2. Peak Velocity ±2 %

8. Instrumentation
   a. Number of Channels — 69 (49 PRIMARY, 20 SECONDARY)
   b. Frequency Response/Class — ALL CLASSES (VARIABLE UP TO 40,000 Hz)
   c. Method of recording
      c.1. Tape — 14 CHANNELS FM
      c.2. Chart — 6 CHANNELS
      c.3. Other (specify) — 49 CHANNEL ANALOGUE TO DIGITAL COVERTER SYSTEM (DATALAB)
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission
   e. Accelerometers
      e.1. Types — PIEZORESISTIVE
      e.2. Dynamic Range — UP TO 5000 G
      e.3. Frequency Range — UP TO 2000 G ±5%
      e.4. Number — VARIABLE TO MEET REQUIREMENTS
         e.4.a. on sled
         e.4.b. on subject/dummy

   f. Other Parameters Monitored: LOADS (BELT, AND INTERNAL DUMMY LOCATIONS); BELT PULL-OUT, ANGULAR ACC; 9 COMPONENT ACCEL. OF BITE-PLATE; HEART RATES, EKG, EMG

NATO/AGARD

Impact Test Facility Survey

ID #2

1. Name and Address of Facility: CENTRE D'ESSAIS EN VOL
   LABORATOIRE DE MÉDECINE AÉROSPATIALE
   91220 BRETIGNY-AIR

2. Name of Director/Manager: MÉDECIN EN CHEF ROBERT AUFFRET

3. Date Facility became operational: 1955

4. Principle of Operation: RAMPE D'ESSAI DES SIEGES EJECTABLES
   SOLID ROCKET

5. Main Use/Test Type: ESSAIS AU CHOC DES ÉQUIPEMENTS DU PILOTE. ESSAIS DES PROPULSEURS DE SIÈGE
   a. Man Rated:
   yes____ no X

6. Descriptive Details
   a. Horizontal ______ c. Vertical X
   b. Track Length ______ d. Tower Height 33m (31m utiles)

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	75kg		
e.2. Width (max)	0,60m		
e.3. Length (max)	1m		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	100kg		
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation	1		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	30g	3g
b. Jolt	100g/s	10g/s
c. Velocity	120m/s	
d. Stroke	25m	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth	X	1 À 40g	COUP PAR COUP
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G ______%
   f.2. Peak Velocity ______%

8. Instrumentation
   a. Number of Channels ______
   b. Frequency Response/Class: INSTRUMENTS AU STANDARD IRIG
   c. Method of recording
      c.1. Tape X
      c.2. Chart X
      c.3. Other (specify) ______
   d. Method of Transmission
      d.1. Flying lead X
      d.2. FM Transmission X
   e. Accelerometers
      e.1. Types: À INDUCTANCE, PIÉZORÉSISTIF
      e.2. Dynamic Range: 0 A 50g
      e.3. Frequency Range ______
      e.4. Number
         e.4.a. on sled: VARIABLE
         e.4.b. on subject/dummy: 9

f. Other Parameters Monitored: COURSE DU CHARIOT RESTITUEE PAR CELLULE PHOTOELECTRIQUE ET DEUX RAMPES DE LAMPES.

NATO/AGARD

Impact Test Facility Survey

ID #3

1. Name and Address of Facility: ORGANISME NATIONAL DE SECURITE ROUTIERE (ONSER) 109 AVE SALVADOR ALLENDE 69500 BRON FRANCE

2. Name of Director/Manager: J. LEROY

3. Date Facility became operational: 1975

4. Principle of Operation: ____

5. Main Use/Test Type: CAR CRASH TEST

a. Man Rated: yes____ no____

6. Descriptive Details
   a. Horizontal: X
   b. Track Length: 20
   c. Vertical: ____
   d. Tower Height: ____

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	500kg		
e.2. Width (max)	0,95m		
e.3. Length (max)	1,70m		

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	300kg		
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	30g	
b. Jolt	100km/h	
c. Velocity		
d. Stroke	1,0m	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle	X		
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G ____ %
   f.2. Peak Velocity 2 %

8. Instrumentation
   a. Number of Channels: 50
   b. Frequency Response/Class: 1000Hz
   c. Method of recording
      c.1. Tape: X
      c.2. Chart: X
      c.3. Other (specify): ____
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission: X
   e. Accelerometers
      e.1. Types: PIÉZORÉSISTIFS
      e.2. Dynamic Range: 10 - 1000g
      e.3. Frequency Range: ____
      e.4. Number
         e.4.a. on sled: 5
         e.4.b. on subject/dummy: 12

f. Other Parameters Monitored: FORCE, PRESSURE

NATO/AGARD

Impact Test Facility Survey

ID #4

1. Name and Address of Facility — CENTRE D'ESSAIS EN VOL
BASE D'ESSAI DE CAZAUX
33630 CAZAUX, FR.

2. Name of Director/Manager — INGENIEUR EN CHEF SIX

3. Date Facility became operational — 1967

4. Principle of Operation — RAIL D'ESSAIS (ROCKET-SOLID FUEL, EJECTION SEAT)

5. Main Use/Test Type — IMPACTS
TRAJECTOIRES ACCELEREES
TRAJECTOIRES A VITESSE CONSTANTE

   a. Man Rated:
   yes____ no X

6. Descriptive Details
   a. Horizontal X   c. Vertical ____
   b. Track Length 600m   d. Tower Height ____

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max) [CHARIOTS	1500kg		
e.2. Width (max) SPECIFIQUES	1m		
e.3. Length (max) A L'ESSAI]	5m		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	1000kg		
f.2. Width (max)	0,8m		
f.3. Length (max)	4m		
f.4. Range of Orientation			

7. Performance Parameters*

	(max)	(min usable)
a. Acceleration	60g	10g
b. Jolt	75g/s	25
c. Velocity	900m/s	20
d. Stroke	150g	10g

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X		
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

*PROPULSION PAR 1 A 86 ROQUETTES DE 68 mm - FREINAGE HYDRODYNAMIQUE OU RETROPROPULSION

   f. Repeatability
      f.1. Peak G 95 %
      f.2. Peak Velocity 90 %

8. Instrumentation
   a. Number of Channels — SUIVANT LE NOMBRE DE TELEMESURES AU STANDARD IRIG
   b. Frequency Response/Class ____
   c. Method of recording
      c.1. Tape X
      c.2. Chart X
      c.3. Other (specify) ____
   d. Method of Transmission
      d.1. Flying lead X
      d.2. FM Transmission X
   e. Accelerometers
      e.1. Types — A INDUCTANCE PIEZOELECTRIQUES
      e.2. Dynamic Range — 10 A 200g
      e.3. Frequency Range ____
      e.4. Number ____
         e.4.a. on sled 1
         e.4.b. on subject/dummy SUIVANTR SON INSTRUMENTATION

   f. Other Parameters Monitored: CAPTEUR DE DEPLACEMENT, POSSIBILITE DE TRAJECTOGRAPHIE PAR CINETHEODOLITES.

NATO/AGARD

Impact Test Facility Survey

ID #5

1. Name and Address of Facility: CENTRE TECHNIQUE RENAULT DE LARDY
F-91 LARDY (FRANCE)

2. Name of Director/Manager: M. PHILIPPE

3. Date Facility became operational: 1975

4. Principle of Operation: ______

5. Main Use/Test Type: ALL TYPES OF ACCIDENT SIMULATIONS OR RECONSTRUCTIONS
   a. Man Rated:
      yes____ no____

6. Descriptive Details
   a. Horizontal ______ c. Vertical ______
   b. Track Length ______ d. Tower Height ______

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	15000kg	15000kg	
e.2. Width (max)	2m	2m	
e.3. Length (max)	5m	5m	

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	10000kg	10000kg	
f.2. Width (max)	2m	2m	
f.3. Length (max)	5m	5m	
f.4. Range of Orientation			

7. Performance Parameters
   a. Acceleration ______(max) ______(min usable)
   b. Jolt ______(max) ______(min usable)
   c. Velocity ______(max) ______(min usable)
   d. Stroke ______(max) ______(min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	NEARLY ANY		
e.2. 1/2 Sine	SHAPE IS		
e.3. Triangle	POSSIBLE		
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G <5 %
      f.2. Peak Velocity 1 %

8. Instrumentation
   a. Number of Channels: 80
   b. Frequency Response/Class: 1000
   c. Method of recording
      c.1. Tape: X
      c.2. Chart: X
      c.3. Other (specify) ______
   d. Method of Transmission
      d.1. Flying lead ______
      d.2. FM Transmission: X
   e. Accelerometers
      e.1. Types ______ ______ ______
      e.2. Dynamic Range ______ ______ ______
      e.3. Frequency Range ______ ______ ______
      e.4. Number
         e.4.a. on sled <80
         e.4.b. on subject/dummy <80

   f. Other Parameters Monitored: FORCE, DEFLEXION OF DUMMY, SPEEDS, ETC.

NATO/AGARD

Impact Test Facility Survey

ID #6, 7, 8, 9

1. Name and Address of Facility: LABORATOIRE DE L'U.T.A.C.
   AUTODROME DE LINAS-MONTLHERY
   91310 MONTLHERY
   FRANCE

2. Name of Director/Manager: GENERAL MANAGER - MR. L.C. MICHELET
   TECHNICAL MANAGER - MR. E. CHAFOUX

3. Date Facility became Operational: 1966

4. Principle of Operation: SANDOW, POWERED WINCH, GRAVITY

5. Main Use/Test Type: CRASH TESTS ON VEHICLES

   a. Man Rated:
      yes____ no X

6. Descriptive Details
   a. Horizontal: 3
   b. Track Length: 6m/20m/400m
   c. Vertical: 1
   d. Tower Height: 4m

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	400kg	600kg	
e.2. Width (max)	1,2m	1,2m	
e.3. Length (max)	1,5m	4m	

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	200kg	700kg	
f.2. Width (max)	1m	2m	
f.3. Length (max)	1,50m	5m	
f.4. Range of Orientation	0 to 180	0 to 180	

7. Performance Parameters
   a. Acceleration: 100g (max) ____ (min usable)
   b. Jolt: ____ (max) ____ (min usable)
   c. Velocity: 100km/h (max) ____ (min usable)
   d. Stroke: ____ (max) ____ (min usable)
   e. Waveform: (Check all that Apply) — Range of Acceleration — Duration

      e.1. Sine
      e.2. Half Sine
      e.3. Triangle
      e.4. Trapezoidal
      e.5. Rectangle
      e.6. Sawtooth
      e.7. Other (indicate)

      WE USE SHOCK IN POLYURETHANE. IT IS POSSIBLE TO OBTAIN DIFFERENT SHAPES OF DECELERATION CURVES VERSUS TIME AND EQUIVALENT PULSES

   f. Reproducibility
      f.1. Peak g: 5 %
      f.2. Peak Velocity: 1 %

8. Instrumentation
   a. Number of Channels: 50
   b. Frequency Response/Class: 60-100-300-600-1000
   c. Method of Recording
      c.1. Tape: YES
      c.2. Chart: YES
      c.3. Other (specify): PAPER RECORDER (U.V.)
   d. Method of Transmission
      d.1. Flying lead: YES
      d.2. FM Transmission: YES
   e. Accelerometers
      e.1. Types: PIÉZO-ÉLECTRIC — PIÉZO-RÉSISTIVE
      e.2. Dynamic Range: 1 À 1000g
      e.3. Frequency Range: 40
      e.4. Number
         e.4.a. on sled: ACCORDING TO TEST
         e.4.b. on subject/dummy: 3 HEAD - 3 THORAX - 3 ABDOMEN

9. Other Parameters Monitored: FORCE, TIME, DISPLACEMENT.

NATO/AGARD

Impact Test Facility Survey

ID #1

1. Name and Address of Facility: INSTITUT FÜER FAHRZEUGTECHNIK
TECHNISCHE UNIVERSITAET BERLIN
STRASSE DES 17 JUNI 135
D-1000 BERLIN 12, W. GER.

2. Name of Director/Manager: PROF. DR. ING. HERMANN APPEL

3. Date Facility became Operational: [illegible]

4. Principle of Operation: [illegible]

5. Main Facility Type: [illegible] CAR - PEDESTRIAN/CYCLE/CAR

a. [illegible]
Yes ____ No ____

6. Descriptive Details

a. Horizontal ____ c. Vertical ____

b. Track Length [illegible] d. Tower Height [illegible]

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	1000kg		
e.2. Width (max)	150cm		
e.3. Length (max)	200cm		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	500kg		
f.2. Width (max)	150cm		
f.3. Length (max)	200cm		
f.4. Range of Orientation	arbitrary		

7. Performance Parameters

a. Acceleration 1.5g (max) ____ (min usable)

b. Jolt ____ (max) ____ (min usable)

c. Velocity 50mph (max) ____ (min usable)

d. Stroke 80mph (max) ____ (min usable)

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X	5-40g	
e.5. Rectangle	X		
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability

f.1. Peak G 5 %

f.2. Peak Velocity 5 %

8. Instrumentation

a. Number of Channels 40

b. Frequency Response/Class 1000

c. Method of recording

c.1. Tape PCM

c.2. Chart

c.3. Other (specify)

d. Method of Transmission

d.1. Flying lead X

d.2. FM Transmission

e. Accelerometers

e.1. Types	ENDEVCO	ENDEVCO	
e.2. Dynamic Range	750g	2500g	
e.3. Frequency Range	2000Hz	9000Hz	
e.4. Number			
e.4.a. on sled	1		
e.4.b. on subject/dummy	9		

f. Other Parameters Monitored: FORCES, FILM

NATO/AGARD

Impact Test Facility Survey

ID #11

1. Name and Address of Facility: IMPACT CATAPULT (KATAPULTANLAGE)
BATTELLE - INSTITUTE V.
AM ROMERHOF 35
D-6000 FRANKFURT AM MAIN 90/W. GERMANY

2. Name of Director/Manager: DIPL.-ING. G. RUTER

3. Date Facility became operational: 1965

4. Principle of Operation: STRETCHED BUNGEE CABLE TO IMPACT STEEL STRIP

5. Main Use/Test Type: PASSENGER SAFETY, ALL TYPES OF VEHICLES

a. Man Rated:
yes X no ____

6. Descriptive Details
a. Horizontal X
b. Track Length 11m
c. Vertical ____
d. Tower Height ____

	Sled #1	Sled #2	Sled #3
e. Sled Characteristics			
e.1. Weight (max)	140kg		
e.2. Width (max)	.85m		
e.3. Length (max)	2.9m		

	Sled #1	Sled #2	Sled #3
f. Payload Characteristics			
f.1. Weight (max)	300kg		
f.2. Width (max)	1.7m		
f.3. Length (max)	3.0m		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	40g	
b. Jolt	2500g/s	
c. Velocity	70km/h	50km/h
d. Stroke	800mm	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X	30g	80ms
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
f.1. Peak G 5 %
f.2. Peak Velocity 1 %

8. Instrumentation
a. Number of Channels: 10
b. Frequency Response/Class: SAE J 211, 211a
c. Method of recording
c.1. Tape
c.2. Chart X
c.3. Other (specify)
d. Method of Transmission
d.1. Flying lead X
d.2. FM Transmission
e. Accelerometers
e.1. Types: Holtinger
e.2. Dynamic Range: up to 600g
e.3. Frequency Range: 6000Hz
e.4. Number
e.4.a. on sled: 1
e.4.b. on subject/dummy: 9 (max)

f. Other Parameters Monitored: FORCES, DISPLACEMENTS

NATO/AGARD

Impact Test Facility Survey

ID #12

1. Name and Address of Facility: KLINIKUM DER UNIVERSITÄT HEIDELBERG INSTITUT FÜR RECHTSMEDIZIN POSTFACH 103069, 6900 HEIDELBERG, FED. REPUBLIC OF GERMANY

2. Name of Director/Manager: PROF. DR. SCHMIDT/DR. KALLIERIS

3. Date Facility became operational: END OF 1972

4. Principle of Operation: DECELERATION SLED

5. Main Use/Test Type: CADAVER TESTS, DUMMY TESTS, FRONTAL, LATERAL, HEAD-ON
   a. Man Rated: yes____ no____

6. Descriptive Details
   a. Horizontal: X
   b. Track Length: 24m
   c. Vertical: ____
   d. Tower Height: ____

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	3787N		
e.2. Width (max)	140cm		
e.3. Length (max)	300cm		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	6000N		
f.2. Width (max)	150cm		
f.3. Length (max)	400cm		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	40g	
b. Jolt		
c. Velocity	100km/h	
d. Stroke		

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X	*	*
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

*DEPENDENT UPON THE SLED VELOCITY AND DECELERATION LEVEL.

f. Repeatability
   f.1. Peak G: 97 %
   f.2. Peak Velocity: 100 %

8. Instrumentation
   a. Number of Channels: 30 (POSSIBLE)
   b. Frequency Response/Class: ____
   c. Method of recording
      c.1. Tape: ____
      c.2. Chart: X
      c.3. Other (specify): ____
   d. Method of Transmission
      d.1. Flying lead: ____
      d.2. FM Transmission: X
   e. Accelerometers

e.1. Types	ENDEVCO 2264		
e.2. Dynamic Range	-2K TO +2K g		
e.3. Frequency Range	27000Hz		
e.4. Number	1		
e.4.a. on sled	21/29		
e.4.b. on subject/dummy			

   f. Other Parameters Monitored: LUNG PRESSURE, BELT FORCES

NATO/AGARD

Impact Test Facility Survey

ID #13

1. Name and Address of Facility — DAIMLER-BENZ AG
7032 SINDELFINGEN 1
POSTFACH 2 26
ENTWICKLUNG PKW AUFBAUTEN EA1, W. GER.

2. Name of Director/Manager — DIPL.-ING. GUNTRAM HUBER

3. Date Facility became operational — JANUARY 1973

4. Principle of Operation — LINEAR MOTOR ACCELERATION TO BARRIER CRASH

5. Main Use/Test Type — CRASH TESTS ON PASSENGER AND COMMERCIAL VEHICLES

a. Man Rated:
yes____ no____

6. Descriptive Details
a. Horizontal __X__ c. Vertical ____
b. Track Length __65__ d. Tower Height ____

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	10,000 kg		
f.2. Width (max)	unlimited		
f.3. Length (max)	unlimited		
f.4. Range of Orientation			

7. Performance Parameters
a. Acceleration ________(max) ________(min usable)
b. Jolt ________(max) ________(min usable)
c. Velocity $13.9\ ms^{-1}$ (max) ________(min usable)
d. Stroke ________(max) ________(min usable)
e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	DEPENDS ON IMPACT SURFACE & VEHICLE DYNAMICS		
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
f.1. Peak G ________%
f.2. Peak Velocity ___1___%

8. Instrumentation
a. Number of Channels — 75
b. Frequency Response/Class — FK 60, 180, 600
c. Method of recording
c.1. Tape
c.2. Chart — X
c.3. Other (specify)
d. Method of Transmission
d.1. Flying lead — X
d.2. FM Transmission
e. Accelerometers
e.1. Types
e.2. Dynamic Range
e.3. Frequency Range
e.4. Number
e.4.a. on sled
e.4.b. on subject/dummy

f. Other Parameters Monitored: HIGH SPEED FILMING

NATO/AGARD

Impact Test Facility Survey

ID #14, 15, 16

1. Name and Address of Facility: DAIMLER-BENZ AG
   7032 SINDELFINGEN 1
   POSTFACH 2 26
   ENTWICKLUNG PKW AUFBAUTEN EA1, W. GER.

2. Name of Director/Manager: DIPL.-ING. GUNTRAM HUBER

3. Date Facility became operational: 1971/1973/1979

4. Principle of Operation: BESCHLEUNIGEN AUS DEM STILLSTAND (BENDIX) - SLED 1
   AUFFAHREN UND RUCKPRALL (MTS) - SLED 2
   AUFFAHREN (EIGENBAU) - SLED 3

5. Main Use/Test Type: FRONTALAUFPRALL/HALTESYSTEME
   a. Man Rated:
      yes____ no____

6. Descriptive Details
   a. Horizontal X
   b. Track Length 65m (max)
   c. Vertical ____
   d. Tower Height ____

	Sled #1	Sled #2	Sled #3
e. Sled Characteristics			
e.1. Weight (max)	1000kg	460kg	180kg
e.2. Width (max)	1220mm	1220mm	960mm
e.3. Length (max)	3675mm	3370mm	1460mm

	Sled #1	Sled #2	Sled #3
f. Payload Characteristics			
f.1. Weight (max)	2500kg	670kg	250kg
f.2. Width (max)	4000mm	4000mm	2000mm
f.3. Length (max)	4300mm	4300mm	2000mm
f.4. Range of Orientation			

7. Performance Parameters
   a. Acceleration 80g (max) ____ (min usable)
   b. Jolt 130 km/h (max) ____ (min usable)
   c. Velocity $9 \cdot 10^5$ N (max) ____ (min usable)
   d. Stroke ____ (max) ____ (min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X		
e.3. Triangle	X		
e.4. Trapezoidal	X		
e.5. Rectangle	X		
e.6. Sawtooth			
e.7. Other (indicate)	FAHRZEUG-SPEZIFISCH		

   f. Repeatability
      f.1. Peak G ±1g
      f.2. Peak Velocity ±0.5 km/h

8. Instrumentation
   a. Number of Channels: 75
   b. Frequency Response/Class: FK 60, 180, 600
   c. Method of recording
      c.1. Tape ____
      c.2. Chart X
      c.3. Other (specify) ____
   d. Method of Transmission
      d.1. Flying lead ____
      d.2. FM Transmission X
   e. Accelerometers

e.1. Types	CEC	Endevco	
e.2. Dynamic Range	250g	750g	
e.3. Frequency Range	1000Hz	2000Hz	
e.4. Number			
e.4.a. on sled	2		
e.4.b. on subject/dummy	6		

   f. Other Parameters Monitored: OBERSCHENKELKRAFTE, UNTERSCHENKELKRAFTE

NATO/AGARD

Impact Test Facility Survey

ID #17

1. Name and Address of Facility — FIAT - CENTRO SICUREZZA, ORBASSANO (TORINO - ITALIA), VIA G. GOZZANO, 2

2. Name of Director/Manager — ENZO FRANCHINI

3. Date Facility became operational — PRESENTED TO THE PRESS MARCH 1977

4. Principle of Operation — HORIZONTAL, CABLEWAY SYSTEM DRIVEN BY A 2300 HP ELECTRIC MOTOR

5. Main Use/Test Type — CAR AND TRACK DEVELOPMENT AND LEGISLATIVE REQUIREMENTS/BARRIER, CAR-TO-CAR, DUMMY AND COMPONENTS TESTS

   a. Man Rated: yes____ no____

6. Descriptive Details
   a. Horizontal 8 tracks
   b. Track Length 30 - 420m
   c. Vertical ______
   d. Tower Height ______

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	20MT		
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation	0-180		

7. Performance Parameters
   a. Acceleration ______(max) ______(min usable)
   b. Jolt ______(max) ______(min usable)
   c. Velocity 140 km/h (max) 50 km/h (min usable)
   d. Stroke ______(max) ______(min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G ______%
      f.2. Peak Velocity ______%

8. Instrumentation
   a. Number of Channels — 96
   b. Frequency Response/Class — 100, 300, 1000, 1650
   c. Method of recording
      c.1. Tape — X
      c.2. Chart — X
      c.3. Other (specify) ______
   d. Method of Transmission
      d.1. Flying lead ______
      d.2. FM Transmission — X
   e. Accelerometers

e.1. Types	PIEZORESISTIVE	PIEZORESISTIVE	PIEZORESISTIVE
e.2. Dynamic Range	200	250	750
e.3. Frequency Range	0 - 1100Hz	0 - 2000Hz	0 - 2000HZ
e.4. Number			
e.4.a. on sled	50		
e.4.b. on subject/dummy	16 Triax		

   f. Other Parameters Monitored: SPEED, TIME ZERO, STRAIN, LOAD, DISPLACEMENT

NATO/AGARD

Impact Test Facility Survey

ID #16

1. Name and Address of Facility — DECELERATION TRACK
ROYAL AIR FORCE
INSTITUTE OF AVIATION MEDICINE
FARNBOROUGH, HANTS U.K.

2. Name of Director/Manager — AIR CDRE P. HOWARD O.B.E.

3. Date Facility became operational — JANUARY 11, 1972

4. Principle of Operation — STRETCHED BUNGEE CORDS ACCELERATE SLED, ARRESTED BY HYDRAULIC CONTROLLED STEEL CABLES

5. Main Use/Test Type — SEAT & HARNESS TESTING WITH DUMMIES & HUMAN SUBJECTS, PHYSIOLOGICAL RESEARCH WITH HUMAN SUBJECTS
   a. Man Rated:
      yes X no ____

6. Descriptive Details
   a. Horizontal ____   c. Vertical ____
   b. Track Length 46m   d. Tower Height ____

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	386kg		
e.2. Width (max)	0.9m		
e.3. Length (max)	4m		

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	250kg		
f.2. Width (max)	3m (overhang acceptable)		
f.3. Length (max)	3m (overhang accepetable)		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50g	2g
b. Jolt	$1000g/sec^{-1}$	
c. Velocity	15m/sec	5.5m/sec
d. Stroke	.9m	

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	2 to 50g	200 to 50msec
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G ±1 %
      f.2. Peak Velocity ±.25 %

8. Instrumentation
   a. Number of Channels — 12 CHANNEL CONTROL CONSOLE
   b. Frequency Response/Class — ____
   c. Method of recording
      c.1. Tape — 14 CHANNEL DC TO 200Hz
      c.2. Chart — U.V. RECORDER 12 CHANNEL DC TO 100Hz
      c.3. Other (specify) — C.R.O.
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission — ____
   e. Accelerometers
      e.1. Types — Kyowa ±50g
      e.2. Dynamic Range — ±50g
      e.3. Frequency Range — D.C. to 750Hz
      e.4. Number
         e.4.a. on sled — 1 Gx on Sled Centre of gravity
         e.4.b. on subject/dummy — As Required, Triaxial on Bite Plate

   f. Other Parameters Monitored: HIGH SPEED FILMING, IMPACT VELOCITY, HARNESS LOADS, SEAT STRUCTURE TENSION LOADS, E.C.G.

NATO/AGARD

Impact Test Facility Survey

ID #19

1. Name and Address of Facility — EJECTION RIG
ROYAL AIRCRAFT ESTABLISHMENT
FARNBOROUGH
HANTS, UK

2. Name of Director/Manager — MR. T. H. KERR

3. Date Facility became operational — CURRENTLY DISMANTLED-TO BE REINSTATED

4. Principle of Operation — EJECTION CATAPULT, GRAVITY BRAKING

5. Main Use/Test Type — EJECTION SYSTEMS, SEAT PACKS, CUSHIONS

a. Man Rated:
yes X no ____

6. Descriptive Details

a. Horizontal ________ c. Vertical INCLINED 20°

b. Track Length ________ d. Tower Height 47.2m

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)			
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation			

7. Performance Parameters

a. Acceleration ca. 20G (max) ________ (min usable)

b. Jolt ca. 300Gs^{-1} (max) ________ (min usable)

c. Velocity 20.9ms^{-1} (95fts^{-1}) (max) ________ (min usable)

d. Stroke ________ (max) ________ (min usable)

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X		
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability

f.1. Peak G ________ %

f.2. Peak Velocity ________ %

8. Instrumentation

a. Number of Channels — 11

b. Frequency Response/Class — DC-100Hz, DC-1kHz

c. Method of recording

c.1. Tape — X

c.2. Chart ________

c.3. Other (specify) — ANALOGUE OUTPUT TO UV RECORDER

d. Method of Transmission

d.1. Flying lead ________

d.2. FM Transmission — X

e. Accelerometers

e.1. Types — SMITH INDUSTRIES ALV692

e.2. Dynamic Range ________

e.3. Frequency Range ________

e.4. Number

e.4.a. on sled ________

e.4.b. on subject/dummy ________

f. Other Parameters Monitored: GUN PRESSURE BY PIEZOELECTRIC TRANSDUCER. HARNESS LOADS BY BUCKLE STRAIN GAUGES. RECORDING FACILITIES DUPLICATED IN MOBILE VAN FOR AIR TO GROUND TELEMETRY OF EJECTION DATA.

NATO/AGARD

Impact Test Facility Survey

ID #20

1. Name and Address of Facility — ROAD SAFETY ENGINEERING LABORATORY
MIDDLESEX POLYTECHNIC
THE BURROUGHS
HENDONS, NW4 4BT, ENGLAND

2. Name of Director/Manager — PETER ROY

3. Date Facility became operational — 30 JANUARY 1981

4. Principle of Operation — ACCELERATED USING RUBBER CORDS

5. Main Use/Test Type — TESTING TO ADULT AND CHILD SEAT BELT STANDARDS

   a. Man Rated:
      yes___ no X

6. Descriptive Details
   a. Horizontal YES
   b. Track Length 33m
   c. Vertical N/A
   d. Tower Height N/A

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	485kgf		
e.2. Width (max)	114cm		
e.3. Length (max)	280cm		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	800kgf		
f.2. Width (max)	5.8m		
f.3. Length (max)	6m		
f.4. Range of Orientation	360°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50*	2
b. Jolt		
c. Velocity	80km/h	5km/h
d. Stroke	1m	50mm

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	YES	20g - 32g	80-100ms
e.3. Triangle			
e.4. Trapezoidal	YES	12g - 14g	**
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

*THIS IS THE MAXIMUM SO FAR ACHIEVED
**THIS IS A FUNCTION OF SLED VELOCITY

   f. Repeatability
      f.1. Peak G 5 %
      f.2. Peak Velocity 4 %

8. Instrumentation
   a. Number of Channels — 16
   b. Frequency Response/Class — CLASS 60
   c. Method of recording
      c.1. Tape — NO
      c.2. Chart — YES
      c.3. Other (specify) — "ON BOARD" MICROPROCESSOR
   d. Method of Transmission
      d.1. Flying lead — YES
      d.2. FM Transmission — NO
   e. Accelerometers
      e.1. Types — PIEZORESISTIVE
      e.2. Dynamic Range — 0-1800g
      e.3. Frequency Range
      e.4. Number
         e.4.a. on sled — 2-Uniaxial
         e.4.b. on subject/dummy — Head-chest triaxial

   f. Other Parameters Monitored: SLED - VELOCITY, DECELERATION; DUMMY - FORWARD MOVEMENT, HEAD & CHEST ACCELERATIONS ON X,Y, & Z AXES; TRAJECTORY USING 8 SHOT POLARIOD AND HIGH SPEED CAMERAS.

NATO/AGARD

Impact Test Facility Survey

ID #21

1. Name and Address of Facility — DEPARTMENT OF HUMAN SCIENCES, UNIVERSITY OF TECHNOLOGY, LOUGHBOROUGH, LEICESTERSHIRE, LE11 3TU, U.K.

2. Name of Director/Manager — J. SANDOVER

3. Date Facility became operational — 1970

4. Principle of Operation — HONEYCOMB & TEAR WEBBING RETARDATION

5. Main Use/Test Type — MAN MODELING

   a. Man Rated: yes____ no____ — NOT U.S. "MAN RATED" BUT SAFE USE FOR HUMAN STUDIES

6. Descriptive Details
   a. Horizontal ________
   b. Track Length ________
   c. Vertical (CAN BE ANGLED TO 30)
   d. Tower Height 6m (2m SLED MOVEMENT)

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	200kg		
e.2. Width (max)	750mm		
e.3. Length (max)	500mm		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	120kg		
f.2. Width (max)	500mm		
f.3. Length (max)	500mm		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	$100 m/s^2$	$10 m/s^2$
b. Jolt		
c. Velocity	$6 m/s^2$	
d. Stroke	500mm	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	(Approx.)	to $100 m/s^2$	0.01s to 0.2s
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G ∿20 %
   f.2. Peak Velocity ______ %

8. Instrumentation
   a. Number of Channels — 6
   b. Frequency Response/Class — 0-500Hz (lowest res. frequency of load measuring table)
   c. Method of recording
      c.1. Tape — X
      c.2. Chart
      c.3. Other (specify)
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission
   e. Accelerometers
      e.1. Types — PIEZO ELECTRIC
      e.2. Dynamic Range — $50k\ m/s^2$
      e.3. Frequency Range — 0-20kHz
      e.4. Number
         e.4.a. on sled
         e.4.b. on subject/dummy — 1
   f. Other Parameters Monitored: LOAD - 300 X 200mm CELL, TO 160kN, 0-500Hz

NATO/AGARD

Impact Test Facility Survey

ID #22

1. Name and Address of Facility: MOTOR INDUSTRY RESEARCH ASSOCIATION, WATLING STREET, NUNEATON, WARKS, ENGLAND CV10 0TU

2. Name of Director/Manager: DR. C. ASHLEY

3. Date Facility became operational: MARCH 1965

4. Principle of Operation: LINEAR INDUCTION MOTOR

5. Main Use/Test Type: VEHICLE IMPACTS AGAINST BARRIERS
   a. Man Rated:
      yes____ no____

6. Descriptive Details
   a. Horizontal: X
   b. Track Length: 51.5
   c. Vertical: ____
   d. Tower Height: ____

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	4536kg		
f.2. Width (max)	5.2 m		
f.3. Length (max)	Unlimited		
f.4. Range of Orientation			

7. *Performance Parameters*
   a. Acceleration: INDETERMINATE (max) ____ (min usable)
   b. Jolt: INDETERMINATE (max) ____ (min usable)
   c. Velocity: UP TO 50 MPH (max) ____ (min usable)
   d. Stroke: INDETERMINATE (max) ____ (min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)	DEPENDING UPON VEHICLE TYPE AND BARRIER		

   f. Repeatability
      f.1. Peak G ____ %
      f.2. Peak Velocity 1 %

8. Instrumentation
   a. Number of Channels: 65 DC TO 10 KHz ON MAGNETIC TAPE
   b. Frequency Response/Class: 65 DC TO 2 KHz ON PAPER
   c. Method of recording
      c.1. Tape
      c.2. Chart
      c.3. Other (specify)
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission
   e. Accelerometers
      e.1. Types: STRAIN GAUGE
      e.2. Dynamic Range: VARIOUS UP TO 750 g
      e.3. Frequency Range
      e.4. Number
         e.4.a. on sled: ANY CHOSEN POSITION
         e.4.b. on subject/dummy

   f. Other Parameters Monitored: HIGH SPEED FILMING, HARNESS AND SKELETAL LOADS, DISPLACEMENTS, CONTACT TIMING, PRESSURES, IMPACT VELOCITY, BARRIER FACE LOADS.

NATO/AGARD

Impact Test Facility Survey

ID #23

1. Name and Address of Facility — MOTOR INDUSTRY RESEARCH ASSOCIATION, WATLING STREET, NUNEATON, WARKS. ENGLAND CV10 0TU, U.K.

2. Name of Director/Manager — DR. C. ASHLEY

3. Date Facility became operational — 10 NOVEMBER 1980

4. Principle of Operation — PNEUMATIC REVERSE IMPACT SLED

5. Main Use/Test Type — STUDY OF VEHICLE OCCUPANT PROTECTION, SEAT BELT SYSTEMS, INERTIA EFFECT ON VEHICLES AND VEHICLE COMPONENTS
   a. Man Rated: yes____ no X

6. Descriptive Details
   a. Horizontal X
   b. Track Length 28m
   c. Vertical ____
   d. Tower Height ____

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	1090kg		
e.2. Width (max)	1.2m		
e.3. Length (max)	3.65m		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	1818kg		
f.2. Width (max)	4.5m		
f.3. Length (max)	4.5m		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50g	
b. Jolt		
c. Velocity	100kph	
d. Stroke	3m	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	50g	130 msecs
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle	X	50g	130 msecs
e.6. Sawtooth	X	50g	130 msecs
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G 2.5 %
   f.2. Peak Velocity 2.5 %

8. Instrumentation
   a. Number of Channels — 28 (FURTHER 26 AVAILABLE)
   b. Frequency Response/Class — 1000/600/180/60
   c. Method of recording
      c.1. Tape — X
      c.2. Chart — ____
      c.3. Other (specify) — GALVANOMETER
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission — ____
   e. Accelerometers
      e.1. Types — STRAIN GAUGE
      e.2. Dynamic Range — VARIOUS UP TO 750g
      e.3. Frequency Range — VARIOUS UP TO 2000Hz
      e.4. Number
         e.4.a. on sled — 1 NORMALLY (MORE AVAILABLE)
         e.4.b. on subject/dummy — 9 NORMALLY

f. Other Parameters Monitored: VEHICLE AND COMPONENTS ACCELEROMETERS, FEMUR LOADS, SEAT BELT LOADS, OTHER FORCES AND DISPLACEMENTS AND VELOCITIES H.S. FILM

NATO/AGARD

Impact Test Facility Survey

ID #24, 25

1. Name and Address of Facility — SIMULA INC., 2223 S. 48TH STREET, TEMPE, ARIZONA 85282

2. Name of Director/Manager — S.P. DESJARDINS

3. Date Facility became operational — PLANNED FOR OCTOBER 1981

4. Principle of Operation — DROP TOWER FOR VERTICAL TESTING, ALSO USED TO PROPEL SLED.

5. Main Use/Test Type — AIRCRAFT SEAT EVALUATION
   a. Man Rated: yes___ no X

6. Descriptive Details
   a. Horizontal X — c. Vertical X
   b. Track Length 45m — d. Tower Height 20m

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)			
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50	
b. Jolt		
c. Velocity	20 m/sec	
d. Stroke		

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X		
e.3. Triangle	X		
e.4. Trapezoidal	X		
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G ____ 5
   f.2. Peak Velocity ____ 5

8. Instrumentation
   a. Number of Channels — 26
   b. Frequency Response/Class — DEP. ON MEASUREMENT & SPECIFIC REQUIREMENTS
   c. Method of recording
      c.1. Tape — X
      c.2. Chart — X
      c.3. Other (specify)
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission
   e. Accelerometers

e.1. Types	STRAIN GAGE	PIEZORESISTIVE	
e.2. Dynamic Range	±100 & ±50g	±100g	
e.3. Frequency Range	500Hz	2000Hz	
e.4. Number			
e.4.a. on sled	3		
e.4.b. on subject/dummy	3		

f. Other Parameters Monitored: RESTRAINT SYSTEM LOADS, FOOTREST LOADS, SEAT ACCELERATIONS, STRUCTURAL DISPLACEMENT

NATO/AGARD

Impact Test Facility Survey

ID #26

1. Name and Address of Facility: CRASHWORTHINESS LABORATORY
SRI INTERNATIONAL
333 RAVENSWOOD AVENUE
MENLO PARK, CA 94025

2. Name of Director/Manager: J. D. COLTON

3. Date Facility became operational: 1972

4. Principle of Operation: PNEUMATIC PISTON

5. Main Use/Test Type: ACCELERATION OF MODEL STRUCTURES

a. Man Rated:
yes____ no____

6. Descriptive Details
a. Horizontal X   c. Vertical ____
b. Track Length 3m   d. Tower Height ____

	Sled #1	Sled #2	Sled #3
e. Sled Characteristics			
e.1. Weight (max)	20 lb		
e.2. Width (max)	18 in		
e.3. Length (max)	36 in		

	Sled #1	Sled #2	Sled #3
f. Payload Characteristics			
f.1. Weight (max)	80 lb		
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation	360°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	300 g	10 g
b. Jolt		
c. Velocity	100 ft/sec	10 ft/sec
d. Stroke	3 ft	3 ft

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth	X	10-300 g	
e.7. Other (indicate)			

f. Repeatability
f.1. Peak G ____ %
f.2. Peak Velocity <5 %

8. Instrumentation
a. Number of Channels: 28
b. Frequency Response/Class: ____
c. Method of recording
c.1. Tape: X
c.2. Chart: ____
c.3. Other (specify): ____
d. Method of Transmission
d.1. Flying lead: X
d.2. FM Transmission: ____
e. Accelerometers
e.1. Types ____
e.2. Dynamic Range ____
e.3. Frequency Range ____
e.4. Number ____
e.4.a. on sled ____
e.4.b. on subject/dummy ____

f. Other Parameters Monitored: ____

NATO/AGARD

Impact Test Facility Survey

No. [illegible]

1. Name and Address of Facility: NAVAL BIODYNAMICS LABORATORY, P.O. BOX 29407, NEW ORLEANS, LA 70189

2. Name of Director/Manager: CHANNING L. EWING, M.D.

3. Date Facility Became Operational: OCTOBER 1972, MAN-RATED JULY 1973

4. Principle of Operation: BENDIX 12 IN. HYGE®

5. Main Use/Test Type: TESTING OF HUMANS & LARGE PRIMATES TO DETERMINE DYNAMIC RESPONSE & RELATION TO INJURIES OF HEAD, NECK, & TORSO. PRIMARILY BIOLOGICAL RESEARCH.
   - a. Man Rated: yes____ no____

6. Descriptive Details
   - a. Horizontal: X
   - b. Track Length: 213m
   - c. Vertical: ____
   - d. Tower Height: ____
   - e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	8900N	2600N	1024N
e.2. Width (max)	1.2m	1.2m	1.2m
e.3. Length (max)	3.05m	2.31m	2.44m

   - f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	22260N	1780N	3350N
f.2. Width (max)	2.4m	1.2m	1.2m
f.3. Length (max)	3.05m	1.6m	1.6m
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	200	1
b. Jolt	10000 G/sec	50 G/sec
c. Velocity	40 m/s	1 m/s
d. Stroke	1.7 m	.05 m

   - e. Waveforms (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	X	RANGE AND DURATION ARE DEPENDENT UPON SLED WEIGHT AND ACCELERATION CONFIGURATION	
e.2. 1/2 Sine	X		
e.3. Triangle			
e.4. Trapezoidal	X		
e.5. Rectangle			
e.6. Sawtooth	X		
e.7. Other (indicate)	IRREGULAR		

   - f. Repeatability
     - f.1. Peak G: ±1 %
     - f.2. Peak Velocity: ±1 %

8. Instrumentation

	INERTIAL	A/D CAPABILITY	PHYSIOLOGICAL
a. Number of Channels	40 (BUFFERED)	24 CH-16 BIT	24 CH
b. Frequency Response/Class	UP TO 5K Hz	64 CH-12 BIT	UP TO 12CH, 10K HZ
c. Method of Recording			
c.1. Tape	X		X
c.2. Chart	X		X
c.3. Other (specify)	MAG DISK W POST RUN D/T TRANSFER		
d. Method of Transmission			
d.1. Flying Lead		X	
d.2. FM Transmission		X	
e. Accelerometers			
e.1. Types	PIEZORESISTIVE		
e.2. Dynamic Range	UP TO 200 G		
e.3. Frequency Range	UP TO 20K HZ		
e.4. Number			
e.4.a. on Sled	3		
e.4.b. on Subject/Dummy	UP TO 19		

f. Other Parameters Monitored: SLED MOUNTED CINE AT UP TO 1000 FRAMES/SEC OPTICALLY SURVEYED FOR 3 DIMENSIONAL ANALYSIS OF MOTORS.

Impact Test Facility Survey

1. Name and Address of Facility: NAVAL BIODYNAMICS LABORATORY [illegible] / [illegible] / NEW ORLEANS, LA [illegible]

2. Name of Director/Manager: [illegible]

3. Date Facility Became Operational: [illegible]

4. Principle of Operation: [illegible]

5. Main Use/Test Type: [illegible] TESTING IN THE VERTICAL (Z) DIRECTION

   a. Man Rated: Yes____ No____

6. Descriptive Details

   a. Horizontal ________
   b. Vertical X
   c. Track Length ________
   d. Tower Height 12.2m

   e. Sled Characteristics: Sled #1 | Sled #2 | Sled #3

      e.1. Weight (max) [illegible]
      e.2. Width (max) [illegible]
      e.3. Length (max) [illegible]

   f. Payload Characteristics: Sled #1 | Sled #2 | Sled #3

      f.1. Weight (max) [illegible]
      f.2. Width (max) [illegible]
      f.3. Length (max) [illegible]
      f.4. Range of Orientation [illegible]

7. Performance Parameters

   a. Acceleration [illegible] (max) [illegible] (min usable)
   b. Jolt [illegible] (max) [illegible] (min usable)
   c. Velocity [illegible] (max) [illegible] m/sec (min usable)
   d. Stroke [illegible] (max) [illegible] (min usable)
   e. Waveforms: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	X		
e.2. 1/2 Sine	X	RANGE AND DURATION ARE DEPEN-	
e.3. Triangle	X	DENT UPON CARRIAGE WEIGHT &	
e.4. Trapezoidal	X	ACCELERATION CONFIGURATION	
e.5. Rectangle			
e.6. Sawtooth	X		
e.7. Other (Indicate)	IRREGULAR		

   f. Repeatability

      f.1. Peak G ±1 %
      f.2. Peak Velocity ±1 %

8. Instrumentation

	INERTIAL	A/D CAPABILITY	PHYSIOLOGICAL
a. Number of Channels	40 (BUFFERED)	24 CH-16 BIT	24 CH
b. Frequency Response/Class	UP TO 5K Hz	64 CH-12 BIT	UP TO 12CH, 1CH 10K Hz
c. Method of recording			
c.1. Tape	X		X
c.2. Chart	X		X
c.3. Other (specify)	MAG DISK W POST RUN D/T TRANSFER		
d. Method of Transmission			
d.1. Flying Lead		X	
d.2. FM Transmission		X	
e. Accelerometers			
e.1. Types	PIEZORESISTIVE		
e.2. Dynamic Range	UP TO 500 G		
e.3. Frequency Range	UP TO 20K Hz		
e.4. Number			
e.4.a. on sled	3		
e.4.b. on subject/dummy	UP TO 16		

f. Other Parameters Monitored: LABORATORY-MOUNTED CAMERAS AT UP TO 1000 FRAMES/SEC. X-RAY CINEMATOGRAPHY AT UP TO 300 FRAMES PER SEC.

NATO/AGARD

Impact Test Facility Survey

ID #29

1. Name and Address of Facility: BIOENGINEERING CENTER, WAYNE STATE UNIVERSITY, DETROIT, MI 48202

2. Name of Director/Manager: A. I. KING

3. Date Facility became operational: 1970

4. Principle of Operation: PNEUMATIC

5. Main Use/Test Type: IMPACT ACCELERATION, BARRIER TEST
   a. Man Rated: yes X no

6. Descriptive Details
   a. Horizontal X
   b. Track Length 40m
   c. Vertical
   d. Tower Height

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	5880N		
e.2. Width (max)	2M		
e.3. Length (max)	3.7M		

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	11000N		
f.2. Width (max)	2M		
f.3. Length (max)	3.7M		
f.4. Range of Orientation	360°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50 G	.5 G
b. Jolt	2500 G/S	50 G/S
c. Velocity	30 M/S	1 M/S
d. Stroke	2 M	.1 M

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	5-50 G	50-300 MS
e.3. Triangle	X	5-50 G	50-300 MS
e.4. Trapezoidal	X	5-50 G	50-300 MS
e.5. Rectangle	X	5-50 G	50-300 MS
e.6. Sawtooth	X	5-50 G	50-300 MS
e.7. Other (indicate)	?	5-50 G	50-300 MS

f. Repeatability
   f.1. Peak G 5 %
   f.2. Peak Velocity 5 %

8. Instrumentation
   a. Number of Channels: 73
   b. Frequency Response/Class: 1000
   c. Method of recording
      c.1. Tape: X
      c.2. Chart: X
      c.3. Other (specify): AID
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission:
   e. Accelerometers

e.1. Types	PIEZO RES	STRAIN GAGE	PIEZO ELEC
e.2. Dynamic Range	0-2000 G	0-200 G	0-1000 G
e.3. Frequency Range	0-1000 Hz	0-500 Hz	10000-40000 Hz
e.4. Number			
e.4.a. on sled	4		
e.4.b. on subject/dummy	36		

f. Other Parameters Monitored: EMG, ECG, LOADS, MOMENTS, PRESSURE, VELOCITY, DISTANCE, ANGLE, GAUSS

NATO/AGARD

Impact Test Facility Survey

ID #30

1. Name and Address of Facility: BIOENGINEERING CENTER
   WAYNE STATE UNIVERSITY
   DETROIT, MI 48202

2. Name of Director/Manager: A. I. KING

3. Date Facility became operational: 1967

4. Principle of Operation: PNEUMATIC

5. Main Use/Test Type: IMPACT ACCELERATION

   a. Man Rated:
      yes X no ___

6. Descriptive Details
   a. Horizontal X
   b. Track Length 20m
   c. Vertical ___
   d. Tower Height ___

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)		5800N	
e.2. Width (max)		2M	
e.3. Length (max)		3.7M	

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)		1200N	
f.2. Width (max)		2M	
f.3. Length (max)		3.7M	
f.4. Range of Orientation		360	

7. Performance Parameters
   a. Acceleration 50 G (max) .5 G (min usable)
   b. Jolt 2500 G/S (max) 50 G/S (min usable)
   c. Velocity 30 M/S (max) 1 M/S (min usable)
   d. Stroke 2 M (max) .1 M (min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	5-50 G	50-300 MS
e.3. Triangle	X	5-50 G	50-300 MS
e.4. Trapezoidal	X	5-50 G	50-300 MS
e.5. Rectangle	X	5-50 G	50-300 MS
e.6. Sawtooth	X	5-50 G	50-300 MS
e.7. Other (indicate)	?	5-50 G	50-300 MS

   f. Repeatability
      f.1. Peak G 5 %
      f.2. Peak Velocity 5 %

8. Instrumentation
   a. Number of Channels 73
   b. Frequency Response/Class 1000
   c. Method of recording
      c.1. Tape X
      c.2. Chart X
      c.3. Other (specify) AID
   d. Method of Transmission
      d.1. Flying lead X
      d.2. FM Transmission ___
   e. Accelerometers

e.1. Types	PIEZO RES	STRAIN GAGE	PIEZO ELEC
e.2. Dynamic Range	0-2000 G	0-200 G	0-1000 G
e.3. Frequency Range	0-1000 Hz	0-500 Hz	10000-40000 Hz
e.4. Number			
e.4.a. on sled	4		
e.4.b. on subject/dummy	36		

   f. Other Parameters Monitored: EMG, ECG, LOADS, MOMENTS, PRESSURE, VELOCITY, DISTANCE, ANGLE, GAUSS

NATO/AGARD

Impact Test Facility Survey

II #-1

1. Name and Address of Facility: BIOENGINEERING CENTER, WAYNE STATE UNIVERSITY, DETROIT, MI 48202

2. Name of Director/Manager: A. I. KING

3. Date Facility became operational: 1966

4. Principle of Operation: PNEUMATIC

5. Main Impact Type: EJECTION

   a. Man Rated: Yes ___ No _X_

6. Descriptive Details
   - a. Horizontal ______
   - b. Track Length ______
   - c. Vertical _X_
   - d. Tower Height _36.5m_

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			1000 N
e.2. Width (max)			.6 M
e.3. Length (max)			.3 M

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)			900 N
f.2. Width (max)			.5 M
f.3. Length (max)			.5 M
f.4. Range of Orientation			30

7. *Performance Parameters*

a. Acceleration	25 G	(max)	1 G	(min usable)
b. Jolt	2500 G/S	(max)	50 G/S	(min usable)
c. Velocity	20 M/S	(max)	1 M/S	(min usable)
d. Stroke	2 M	(max)	2 M	(min usable)

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X	0-25 G	50-250 MS
e.5. Rectangle	X	1	1
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
- f.1. Peak G _5_ %
- f.2. Peak Velocity _5_ %

8. Instrumentation
   - a. Number of Channels: 40
   - b. Frequency Response/Class: 1000
   - c. Method of recording
     - c.1. Tape: X
     - c.2. Chart: X
     - c.3. Other (specify): AID
   - d. Method of Transmission
     - d.1. Flying lead: X
     - d.2. FM Transmission: ______
   - e. Accelerometers

e.1. Types	PIEZO RES	STRAIN GAGE	PIEZO ELEC
e.2. Dynamic Range	0-2000 G	0-200 G	0-1000 G
e.3. Frequency Range	0-1000 Hz	0-500 Hz	10000-40000 Hz
e.4. Number			
e.4.a. on sled	4		
e.4.b. on subject/dummy	36		

f. Other Parameters Monitored: EMG, ECG, LOADS, MOMENTS, PRESSURE, VELOCITY, DISTANCE, ANGLE, GAUSS

NATO/AGARD

Impact Test Facility Survey

ID #32

1. Name and Address of Facility — DYNAMIC TEST FACILITY, FEDERAL AVIATION ADMINISTRATION, TECHNICAL CENTER, ATLANTIC CITY AIRPORT, NJ 08405

2. Name of Director/Manager — CAESER A. CAIAFA

3. Date Facility became operational — PNEUMATIC

4. Principle of Operation — CRASHWORTHINESS TESTING OF A/C STRUCTURES AND SEATS

5. Main Use/Test Type ____

   a. Man Rated: yes____ no X

6. Descriptive Details
   a. Horizontal X
   b. Track Length 91 m
   c. Vertical ____
   d. Tower Height ____

   e. Sled Characteristics

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)			
e.2. Width (max)			
e.3. Length (max)			

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	2860Kg		
f.2. Width (max)	N/A		
f.3. Length (max)	91 m		
f.4. Range of Orientation	N/A		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	15g at 2860Kg	
b. Jolt		
c. Velocity	27.3 m/s at 2860Kg	
d. Stroke	91 m	

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability
   f.1. Peak G ____%
   f.2. Peak Velocity ____%

8. Instrumentation
   a. Number of Channels — IN THE PROCESS OF UPDATING
   b. Frequency Response/Class ____
   c. Method of recording
      c.1. Tape ____
      c.2. Chart ____
      c.3. Other (specify) ____
   d. Method of Transmission
      d.1. Flying lead ____
      d.2. FM Transmission ____
   e. Accelerometers
      e.1. Types ____
      e.2. Dynamic Range ____
      e.3. Frequency Range ____
      e.4. Number ____
         e.4.a. on sled ____
         e.4.b. on subject/dummy ____

   f. Other Parameters Monitored: ____

NATO/AGARD

Impact Test Facility Survey

ID #33

1. Name and Address of Facility: CALSPAN CORPORATION, ADVANCED TECHNOLOGY CENTER, 4455 GENESSEE STREET, BUFFALO, NEW YORK 14225

2. Name of Director/Manager: ANTHONY L. RUSSO

3. Date Facility became operational: OCTOBER 1968

4. Principle of Operation: HYGEE 12"

5. Main Use/Test Type: RESTRAINT SYSTEM RESEARCH, BIOMECHANICS RESEARCH
   a. Man Rated: yes X no

6. Descriptive Details
   a. Horizontal X
   b. Track Length 27 m
   c. Vertical
   d. Tower Height

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	2030 lb		
e.2. Width (max)	4 ft		
e.3. Length (max)	12 ft		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	3500 lb		
f.2. Width (max)	12 ft		
f.3. Length (max)	20 ft		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	72 G_x	2 G_x
b. Jolt		
c. Velocity	55 mph	5 mph
d. Stroke	8 ft	1 ft

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	3-50 G_x	50-120 ms
e.3. Triangle	X	>55 G_x	20-50 ms
e.4. Trapezoidal	X	5-40 G_x	60-150 ms
e.5. Rectangle			
e.6. Sawtooth		>55 G_x	20-50 ms
e.7. Other (indicate)	SPECIAL CRASH PULSES	>70 G_x	50-150 ms

f. Repeatability
   f.1. Peak G 2.5 %
   f.2. Peak Velocity 2.5 %

8. Instrumentation
   a. Number of Channels: 54
   b. Frequency Response/Class: 1000, 600, 180, 60
   c. Method of recording
      c.1. Tape: X (FM)
      c.2. Chart:
      c.3. Other (specify): DIRECT DIGITAL DATA ACQUISITION (DDAS)
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission:
   e. Accelerometers

e.1. Types	CEC	ENDEVCO	KISTLER
e.2. Dynamic Range	±250 g	±750 g	±100 g
e.3. Frequency Range	2000 Hz		1000 Hz
e.4. Number	1500		
e.4.a. on sled	>100		
e.4.b. on subject/dummy	>40		

f. Other Parameters Monitored: FEMUR LOADS, PRESSURE, VELOCITY, DISTANCE AND DYNAMIC LOADS.

NATO/AGARD

Impact Test Facility Survey

ID #34

1. Name and Address of Facility: INLAND DIVISION, GENERAL MOTORS
DEPARTMENT 85 F3-1
P.O. BOX 1224
DAYTON, OHIO 45401

2. Name of Director/Manager: J. J. O'CONNELL

3. Date Facility became operational: AUGUST, 1971

4. Principle of Operation: IMPACTS SHOCK ABSORBER

5. Main Use/Test Type: AUTO SAFETY DEVELOPMENT

   a. Man Rated:
   yes____ no X

6. Descriptive Details
   a. Horizontal X
   b. Track Length 11m
   c. Vertical ____
   d. Tower Height ____

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	600 lbs		
e.2. Width (max)	6 ft		
e.3. Length (max)	7 ft		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	1900 lbs		
f.2. Width (max)	12 ft		
f.3. Length (max)	7 ft		
f.4. Range of Orientation	90°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	50 G	
b. Jolt		
c. Velocity	40 mph	
d. Stroke	54 in	

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)	PROGRAMMABLE-TO SIMULATE GIVEN VEHICLE		

   f. Repeatability
      f.1. Peak G ____ %
      f.2. Peak Velocity 2 %

8. Instrumentation
   a. Number of Channels: 60
   b. Frequency Response/Class: 60, 180, 600, 1000
   c. Method of recording
      c.1. Tape: X (FM)
      c.2. Chart: X
      c.3. Other (specify): ____
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission: ____
   e. Accelerometers

e.1. Types	PIEZORESTIVE	ENDEVCO	7231-75
e.2. Dynamic Range	750 g		
e.3. Frequency Range	0-2000 Hz		
e.4. Number	50		
e.4.a. on sled	1		
e.4.b. on subject/dummy	6		

   f. Other Parameters Monitored: TIBIA LOADS, FEMUR LOADS, NECK LOADS

NATO/AGARD

Impact Test Facility Survey

ID #35

1. Name and Address of Facility — TRANSPORTATION RESEARCH CENTER OF OHIO
EAST LIBERTY, OHIO 43319

2. Name of Director/Manager — SIDNEY JEFFE

3. Date Facility became operational — 1973

4. Principle of Operation — HYGE ACCELERATOR (BENDIX 24")

5. Main Use/Test Type — IMPACT SIMULATION FOR AUTOMOTIVE AND AIRCRAFT OCCUPANT PROTECTION SYSTEMS.

   a. Man Rated:
   yes____ no_X_

6. Descriptive Details
   a. Horizontal __X__ c. Vertical ____
   b. Track Length ____ d. Tower Height ____

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	3600 lb		
e.2. Width (max)	1.5 m		
e.3. Length (max)	3.6 m		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	10000 lb		
f.2. Width (max)	9 m		
f.3. Length (max)	6 m		
f.4. Range of Orientation	360°		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	100 g	2 g
b. Jolt		
c. Velocity	100 mph	5 mph
d. Stroke	6 ft	0.1 ft

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	2 - 100 g	50,65,80,100 ms
e.3. Triangle			
e.4. Trapezoidal	X	5 - 50 g	100 & 130 ms
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)	DOUBLE HUMP	24 g	100 ms

f. Repeatability
   f.1. Peak G __1__ %
   f.2. Peak Velocity __1__ %

8. Instrumentation
   a. Number of Channels — 64
   b. Frequency Response/Class — SAE J211A
   c. Method of recording
      c.1. Tape — X
      c.2. Chart — X
      c.3. Other (specify) —
   d. Method of Transmission
      d.1. Flying lead — X
      d.2. FM Transmission —

e. Accelerometers	ENDEVCO	ENDEVCO	ENDEVCO	CEC
e.1. Types	7232C	2260C	7267C-TRIAX	4-202
e.2. Dynamic Range	±750g	±250g	±750 g	±25-±250g
e.3. Frequency Range	0-2000Hz	0-2000Hz	0-2000 Hz	0-2000Hz
e.4. Number				
e.4.a. on sled	3			
e.4.b. on subject/dummy	61 MAX			

f. Other Parameters Monitored: PRESSURE, FORCE, DISPLACEMENT, STRAIN, TEMPERATURE.

NATO/AGARD

Impact Test Facility Survey

ID #36

1. Name and Address of Facility: VERTICAL DECELERATION TOWER
BIOMECHANICAL PROTECTION BRANCH
BIODYNAMICS & BIOENGINEERING DIVISION
AFAMRL, WPAFB, OHIO 45433

2. Name of Director/Manager: JAMES W. BRINKLEY

3. Date Facility became operational: 1962

4. Principle of Operation: FREEFALL OF CARRIAGE AND PLUNGER ONTO A WATER FILLED CYLINDER

5. Main Use/Test Type: TEST SEATS, RESTRAINT SYSTEMS & VEHICLES, PHYSIOLOGICAL & BIODYNAMIC RESEARCH
   a. Man Rated:
      yes X no ___

6. Descriptive Details
   a. Horizontal ___
   b. Track Length ___
   c. Vertical X
   d. Tower Height 15.2 m

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	909 kg (2000 lb)		
e.2. Width (max)	91 cm (36 in)		
e.3. Length (max)	183 cm (83 in)		

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	909 kg (2000 lb)		
f.2. Width (max)	91 cm (36 in)		
f.3. Length (max)	183 cm (72 in)		
f.4. Range of Orientation			

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	80 g at 227 kg payload	
b. Jolt	10g/20msec	
c. Velocity	17 m/s (56 ft/sec)	
d. Stroke	1.2 m (4 ft)	

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X		
e.3. Triangle	X		
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G 7.5 %
      f.2. Peak Velocity 7.5 %

8. Instrumentation
   a. Number of Channels: 50
   b. Frequency Response/Class: 0-200Hz @ 1K sample rate; sample rate variable to 10K with on board A/D
   c. Method of recording
      c.1. Tape: 0-2K ANALOG
      c.2. Chart: X
      c.3. Other (specify): ON-BOARD A/D, TRANSMITTED TO DISK STORAGE
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission: X
   e. Accelerometers
      e.1. Types: PIEZORESISTIVE
      e.2. Dynamic Range: 500 g
      e.3. Frequency Range: 0-3K
      e.4. Number: 25
         e.4.a. on sled: 1
         e.4.b. on subject/dummy: AS REQUIRED

   f. Other Parameters Monitored: FORCE, VELOCITY, DISPLACEMENT, AND PHYSIOLOGICAL PARAMETERS

NATO/AGARD

Impact Test Facility Survey

ID #37

1. *Name and Address of Facility* — VERTICAL ACCELERATOR
BIOMECHANICAL PROTECTION BRANCH
BIODYNAMICS & BIOENGINEERING DIVISION
AFAMRL, WPAFB, OH 45433

2. Name of Director/Manager — JAMES W. BRINKLEY

3. Date Facility became operational — MARCH 1977

4. Principle of Operation — 6" HYGE DEVICE AIR PRESSURE ACTION ON PISTON TO APPLY THRUST TO A CARRIAGE.

5. Main Use/Test Type — TEST INSTRUMENTATION, RESTRAINT SYSTEM COMPONENTS, & MODEL METERING PINS FOR 24" IMPULSE ACCELERATOR. UTILIZE SMALL & MEDIUM SIZE PRIMATES. BIODYNAMIC RESEARCH

   a. Man Rated:
   yes____ no X

6. Descriptive Details
   a. Horizontal ________ c. Vertical X
   b. Track Length ________ d. Tower Height 6.1m

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	40 kg (88.0 lb)		
e.2. Width (max)	77 cm (30.5 in)		
e.3. Length (max)	46 cm (18.0 in)		

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	57 kg (125.0 lb)		
f.2. Width (max)	77 cm (30.5 in)		
f.3. Length (max)	91 cm (36.0 in)		
f.4. Range of Orientation			

7. *Performance Parameters* 178 KN MAXIMUM THRUST

	(max)	(min usable)
a. Acceleration	150 g	8.0
b. Jolt, Acceleration*	32000 g/sec	
c. Velocity	18m/s(59 ft/sec)	
d. *Stroke*	48 cm (19 in)	

*THRUST COLUMN IS CAPABLE OF RAPID DECELERATION WHEN USED WITH DECELERATION METERING PIN AND HYDRAULIC FLUID. JOLT, DECELERATION 100,000 g/sec.

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X		
e.3. Triangle			
e.4. Trapezoidal	X		
e.5. Rectangle	X		
e.6. Sawtooth	X		
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G 2 %
      f.2. Peak Velocity 2 %

8. Instrumentation
   a. Number of Channels 9
   b. Frequency Response/Class 2K
   c. Method of recording
      c.1. Tape X
      c.2. Chart
      c.3. Other (specify)
   d. Method of Transmission
      d.1. Flying lead X
      d.2. FM Transmission
   e. Accelerometers
      e.1. Types PIEZORESISTIVE
      e.2. Dynamic Range 250 g
      e.3. Frequency Range DC - 2HKz
      e.4. Number
         e.4.a. on sled 1
         e.4.b. on subject/dummy AS REQUIRED

   f. Other Parameters Monitored: VELOCITY, FORCE, AND DISPLACEMENT.

NATO/AGARD

Impact Test Facility Survey

ID #30

1.	Name and Address of Facility	SQUARE WAVE IMPACT SYSTEM (SWISMODE) BIOMECHANICAL PROTECTION BRANCH AFAMRL/BBP, AREA B, BLDG 824 W-PAFB, OH 45433
2.	Name of Director/Manager	JAMES W. BRINKLEY
3.	Date Facility became operational	
4.	Principle of Operation	FREE/FALL CARRIAGE ON METAL HONEYCOMB
5.	Main Use/Test Type	STUDIES OF IMPACTED ANIMALS
	a. Man Rated: yes____ no X	

6. Descriptive Details

a. Horizontal		c. Vertical	X
b. Track Length		d. Tower Height	14.9m

	Sled #1	Sled #2	Sled #3
e. Sled Characteristics			
e.1. Weight (max)	277kg/610lb	316kg/695lb	
e.2. Width (max)	71 cm/28 in	71 cm/28 in	
e.3. Length (max)	121cm/47.5in	137cm/54 in	

	Sled #1	Sled #2	Sled #3
f. Payload Characteristics			
f.1. Weight (max)	45.5kg/100lb	45.5kg/100lb	
f.2. Width (max)			
f.3. Length (max)			
f.4. Range of Orientation	+Gz	+5° to 30° +Gz	

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	600 g	10 g
b. Jolt		
c. Velocity	14 m/s (46 ft/sec)	4.3 m/s (14 ft/sec)
d. Stroke		

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle	X	10-200 g	2-24 ms
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability

f.1. Peak G	10 %
f.2. Peak Velocity	3 %

8. Instrumentation

a. Number of Channels	30
b. Frequency Response/Class	2KHz
c. Method of recording	
c.1. Tape	X
c.2. Chart	X
c.3. Other (specify)	
d. Method of Transmission	
d.1. Flying lead	X
d.2. FM Transmission	

e. Accelerometers			
e.1. Types	PIEZORESISTIVE	STRAIN GAUGE	PIEZOELECTRIC
e.2. Dynamic Range	0-250	0-250	0-250
e.3. Frequency Range	DC-2KHz	DC-2KHz	2-2KHz
e.4. Number			
e.4.a. on sled	21		
e.4.b. on subject/dummy	9		

f. Other Parameters Monitored: HARNESS LOADS, SEAT LOADS, AND VELOCITY

1. [illegible] | [illegible]

2. [illegible] Director/Manager | [illegible]

3. Date Facility Became Operational | MARCH, 1976

4. Principle of Operation | STORED ENERGY FLYWHEEL ACCELERATES SLED FOR 23 m (75 ft) [illegible] A CONTROLLABLE LAUNCH VELOCITY, SLED COASTS FOR 38 m (125 ft) & IS DECELERATED BY 5 FOOT PISTON [illegible] WATER [illegible] CYLINDER.

5. Main Use/Test Type | SEAT/RESTRAINT SYSTEM TESTING, [illegible] NAMIC & PHYSIOLOGICAL RESEARCH WITH HUMANS, DUMMIES, & ANIMALS, [illegible] SYSTEM COMPONENT TESTING.

   a. Man Rated: yes X no ___

6. Descriptive Details
   - a. Horizontal X
   - b. Track Length 70.2m
   - c. Vertical ___
   - d. [illegible] ___
   - e. Sled Characteristics: | Sled #1 | Sled #2 | [illegible]
     - e.1. Weight (max) | 1102kg/2000lb | 1094kg/2400lb
     - e.2. Width (max) | 1.2 m/4 ft | 1.2 m/4 ft
     - e.3. Length (max) | 1.8 m/6 ft | 1.8 m/6 ft
   - f. Payload Characteristics | Sled #1 | Sled #2 | [illegible]
     - f.1. Weight (max) | [illegible]/1400 lb | [illegible]/2000 lb
     - f.2. Width (max) | 2.4 m/8 ft | 2.4 m/8 ft
     - f.3. Length (max) | 3.7 m/12 ft | 3.7 m/12 ft
     - f.4. Range of Orientation | X,Y | X,Y

7. Performance Parameters
   - a. Acceleration | 100 G (max) | 2.5 G (min [illegible])
   - b. Jolt | 10000 G/s (max) | 500 G/s (min [illegible])
   - c. Velocity | 38 m/s (125 ft/s) (max) | 1.5 m/s (5 ft/s) (min [illegible])
   - d. Stroke | 152 cm (60 in) (max) | 15 cm (6 in) (min [illegible])
   - e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	≤100	[illegible]
e.3. Triangle	X	≤100	[illegible]
e.4. Trapezoidal	X	≤100	[illegible]
e.5. Rectangle			
e.6. Sawtooth	X	≤100	[illegible]
e.7. Other (indicate)	IRREGULAR		

   - f. Repeatability
     - f.1. Peak G 2 %
     - f.2. Peak Velocity 3

8. Instrumentation
   - a. Number of Channels 50
   - b. Frequency Response/Class 0-200Hz @ 1K sample rate; sample rate variable to 10K with on board A/D
   - c. Method of recording
     - c.1. Tape 0-2KHZ ANALOG
     - c.2. Chart X
     - c.3. Other (specify) ON-BOARD A/D, TRANSMITTED TO [illegible]
   - d. Method of Transmission
     - d.1. Flying lead X
     - d.2. FM Transmission X
   - e. Accelerometers
     - e.1. Types | PIEZORESISTIVE | PIEZOELECTRIC | STRAIN GAGE
     - e.2. Dynamic Range | 500 G | 250 G | 25 G
     - e.3. Frequency Range | 0-3KHZ | 0-3KHZ | [illegible]
     - e.4. Number | 25
       - e.4.a. on sled 5
       - e.4.b. on subject/dummy 0-12
   - f. Other Parameters Monitored: SLED VELOCITY, BELT LOADS, SEAT LOADS, FOOT LOADS, TELEMETRY ECG, AND BODY SEGMENT DISPLACEMENTS.

NATO/AGARD

Impact Test Facility Survey

ID #40

1. Name and Address of Facility: IMPULSE ACCELERATOR
BIOMECHANICAL PROTECTION BRANCH
BIODYNAMICS & BIOENGINEERING DIVISION
AFAMRL, W-PAFB, OH 45433

2. Name of Director/Manager: JAMES W. BRINKLEY

3. Date Facility became operational: 26 JUNE 1972

4. Principle of Operation: DIFFERENTIAL GAS PRESSURES CONTROLLED BY METERING PINS IN ORIFICE

5. Main Use/Test Type: IMPACT TESTS ON SEATS, RESTRAINTS AND VEHICLES USING DUMMIES, HUMANS, AND ANIMAL SUBJECTS
   a. Man Rated:
      yes X no ___

6. Descriptive Details
   a. Horizontal X
   b. Track Length 76m
   c. Vertical ___
   d. Tower Height ___

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	818kg/1800lb	364kg/800lb	
e.2. Width (max)	5.2 m/4 ft	5.2 m/4 ft	
e.3. Length (max)	1.8 m/6 ft	1.8 m/6 ft	

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	4550kg/10K lb	1450kg/3200 lb	
f.2. Width (max)	3.7 m/12 ft	3.7 m/12ft	
f.3. Length (max)	UNDEFINED	UNDEFINED	
f.4. Range of Orientation	NO LIMIT		

7. Performance Parameters

a. Acceleration	150g's @ 227kg payload	(max)	1 g	(min usable)
b. Jolt	4000 g/sec	(max)	50 g/sec	(min usable)
c. Velocity	51.5 m/s (169 fps)	(max)	.3 m (1fps)	(min usable)
d. Stroke	2.6 m (8.4 ft)	(max)	.3 m (1 ft)	(min usable)

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	1-150 g	55 ms
e.3. Triangle	X	1-150 g	70 ms
e.4. Trapezoidal	X	1-150 g	50 ms
e.5. Rectangle	X	1-150 g	35 ms
e.6. Sawtooth	X	1-150 g	70 ms
e.7. Other (indicate)	COMPOUND	1-150 g	

   f. Repeatability
      f.1. Peak G <1 %
      f.2. Peak Velocity <1 %

8. Instrumentation
   a. Number of Channels: 50
   b. Frequency Response/Class: 10KHz
   c. Method of recording
      c.1. Tape: X
      c.2. Chart: X
      c.3. Other (specify): DIGITAL
   d. Method of Transmission
      d.1. Flying lead: X
      d.2. FM Transmission: X
   e. Accelerometers

e.1. Types	PIEZORESISTIVE	PIEZOELECTRIC	STRAIN GAUGE
e.2. Dynamic Range	250 g	250 g	250 g
e.3. Frequency Range	0-3KHz	0-3KHz	0-250 Hz
e.4. Number			
e.4.a. on sled	6		
e.4.b. on subject/dummy	9		

   f. Other Parameters Monitored: BELT LOADS, SLED VELOCITY, SEAT LOADS, BACKREST LOADS, SLED DISPLACEMENT, HIGH-SPEED PHOTOGRAPHY OF BODY SEGMENT MOTION

[illegible]

1. [illegible]: [illegible] CIVIL AEROMEDICAL INSTITUTE, [illegible], OKLAHOMA CITY, OKLAHOMA [illegible]

2. [illegible]: RICHARD F. CHANDLER

3. [illegible] operational: [illegible]

4. Principle of Operation: PLASTIC DEFORMATION OF METAL WIRE

5. [illegible] Type: SEAT/RESTRAINT EVALUATION

a. [illegible]

6. [illegible]
a. Horizontal [illegible]
b. [illegible]
c. Vertical
d. Tower Height

	Sled #1	Sled #2	Sled #3
[illegible] Characteristics			
Weight (max)	400 Kg	400 Kg	
Width (max)	1.2 m	1.2 m	
Length (max)	[illegible]	[illegible]	

	Sled #1	Sled #2	Sled #3
Payload Characteristics			
Weight (max)	NOTE 1	100 Kg	
Width (max)		[illegible]	
Length (max)		3.5 m	
Range of Orientation		10° R, 20° PITCH	

7. Performance Parameters (Note 1)
a. Acceleration: [illegible] (max) [illegible] (min usable)
b. Jolt: 2000 [illegible]/sec (max) 50 [illegible]/sec (min [illegible])
c. Velocity: 20 m/sec (max) (min usable)
d. Stroke: [illegible] m (max) (min usable)

Waveform: (Check all that apply)

		Range of Acceleration	Duration
[illegible]		(NOTE 2)	
[illegible]	X		
[illegible]	X		
Trapezoidal	X		
[illegible]			
[illegible]	X		
[illegible]			

[illegible] Repeatability
[illegible] [illegible] ([illegible], at [illegible])
[illegible] [illegible] ([illegible], at 13.5 m/s)

8. [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] X
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] FORCE, DISPLACEMENT

NOTE 1. [illegible] FACILITY. DATA SHOWN IS TYPICAL MAX. [illegible] CHARACTERISTICS ARE LIMITED BY THE FOLLOWING: (A) [illegible] LIMITED BY MAXIMUM KINETIC ENERGY OF 250 KJ. (B) [illegible] LIMITED BY MAXIMUM BREAKING FORCE OF [illegible] KN.

NATO-AGARD

Impact Test Facility Survey

II [illegible]

1. Name and Address of Facility — HORIZONTAL ACCELERATOR
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PA 18974

2. Name of Director/Manager — WILLIAM [illegible]/MARVIN SCHULMAN

3. Date Facility Became Operational — JANUARY [illegible] (PLANNED)

4. Principle of Operation — HYGE [illegible] ACCELERATOR

5. Main Use/Test Type — TEST AND EVALUATION OF SEATING AND RESTRAINT SYSTEMS, ENERGY ATTENUATING DEVICES, [illegible] STUDIES, VARIOUS AIRCRAFT SYSTEMS.

a. Man Rated:
yes X no ___ Planned

6. Descriptive Details
a. Horizontal X
b. Track Length 30.5 m
c. Vertical ___
d. Tower Height ___

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	907.2kg (2000 lb)		
e.2. Width (max)	1.2m (4ft)		
e.3. Length (max)	3.7m (12ft)		

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	1360kg (3000 lb)		
f.2. Width (max)	WITH ALLOW-		
f.3. Length (max)	ABLE OVER-		
f.4. Range of Orientation	HANG		

7. Performance Parameters
a. Acceleration 240 @ 5000 LB/500 @ 1200 LB (max) ___ (min usable)
b. Jerk ___ (max) ___ (min usable)
c. Velocity 30.5m/sec (100 ft/sec) (max) ___ (min usable)
d. Stroke 1.5m (5 ft) (max) ___ (min usable)
e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine	X	40 G	100 msec
e.3. Triangle	X	40 G	100 msec
e.4. Trapezoidal	X	30 G	100 msec
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (Indicate)	DOUBLE HUMP		

f. Repeatability
f.1. Peak G ±1.5 %
f.2. Peak Velocity ±2.5 %

8. Instrumentation
a. Number of Channels — [illegible] (PLANNED)
b. Frequency Response/Channel — 1 KHz/1000
c. Method of Recording
c.1. Tape — X
c.2. Chart — X
c.3. Other (Specify) —
d. Method of Transmission
d.1. Hard Wire — X
d.2. FM Transmission —
e. Accelerometers

e.1. Types	STRAIN GAGE		
e.2. Dynamic Range	±100 G		
e.3. Frequency Range	0 TO 750 HZ		
e.4. Number			
e.4.1. [illegible]	2		
e.4.2. [illegible]	[illegible]		

f. Other Parameters Monitored: PRESSURE, FORCE, DISPLACEMENT, HIGH SPEED PHOTOGRAPHY, BIOMEDICAL MEASUREMENT

NATO/AGARD

Impact Test Facility Survey

ID #45

1. Name and Address of Facility: EJECTION SEAT TOWER / NAVAL AIR DEVELOPMENT CENTER / WARMINSTER, PA 18974

2. Name of Director/Manager: [illegible]

3. Date Facility became operational: [illegible]

4. Principle of operation: BALLISTIC PRESSURE FOR PROPULSION TESTING AND EVALUATION

5. Main Use/Test Type: EJECTION SEATS, EJECTION SEAT SUB-SYSTEMS, HUMAN SUBJECT PHYSIOLOGICAL ACCEPTANCE
   a. Man rated: yes X no ___

6. Descriptive Details
   a. Horizontal ___
   b. Track Length ___
   c. Vertical X
   d. Tower Height [illegible]

   e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	68kg (150 lb)		
e.2. Width (max)	0.6m (2 ft)		
e.3. Length (max)	2.4 m (8 ft)		

   f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	362.9kg (800 lb)		
f.2. Width (max)	2.1m (7 ft)		
f.3. Length (max)	3.1m (10 ft)		
f.4. Range of Orientation	21° FIXED		

7. Performance Parameters

	(max)	(min usable)
a. Acceleration	30G	4 G
b. Jolt	3000 G/SEC	30 G/SEC
c. Velocity	22.9 m/sec (75 ft/sec)	7.6m/sec (25ft/sec)
d. Stroke	1.9 m (6.2 ft)	1M (3.5FT)

   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal	X	4?-30 G	120-300 msec
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

   f. Repeatability
      f.1. Peak G ±5 %
      f.2. Peak Velocity ±5 %

8. Instrumentation
   a. Number of Channels: 25 (UP TO 14 ON MAGNETIC TAPE)
   b. Frequency Response/Class: 1 KHz/1000
   c. Method of recording
      c.1. Tape: X
      c.2. Chart: X
      c.3. Other (specify): OSCILLOGRAPH
   d. Method of Transmission
      d.1. Trailing Lead: X
      d.2. FM Transmission: ___
   e. Accelerometers
      e.1. Type: STRAIN GAGE
      e.2. Dynamic Range: ±100 G
      e.3. Frequency Range: 0 TO 750Hz
      e.4. Number: 2
         e.4.a. on sled: 9
         e.4.b. on subject/dummy: ___

   f. Other Parameters Monitored: PRESSURES, DISPLACEMENT, FORCE, MOTION, HIGH SPEED PHOTOGRAPHY, BIOMEDICAL MONITORING, ANGULAR ROTATION

[illegible]

[illegible]

[illegible]

1. Name and Address of Facility — [illegible]
[illegible] CENTER
[illegible], PA [illegible]

2. Name of Director/Manager — [illegible]

3. Date Facility Became Operational — 19[illegible]

4. Principle of Operation — [illegible] OF CART BY [illegible] SYSTEM

5. Main Use/Test Type — TEST & EVALUATE CRASH PROTECTIVE DEVICES, RESTRAINT SYSTEMS, SEATING SYSTEMS, CRASHWORTHINESS STUDIES, HUMAN TOLERANCE.

a. Human Use: Yes ___ No ___

6. Descriptive Details

a. Horizontal ________
b. Track Length ________
c. Vertical ____X____
d. Power Source [illegible]

e. Sled Characteristics

	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	[illegible] (1500 lb)		
e.2. Width (max)	[illegible] (10 ft)		
e.3. Length (max)	13.1 [illegible] (10 ft)		

f. Payload Characteristics

	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	[illegible] (700 lb)		
f.2. Width (max)	13.1[illegible] (10 ft)		
f.3. Length (max)	[illegible] (10 ft)		
f.4. Range of Orientation	[illegible] 30° Pitch, 10° roll		

7. Performance Parameters

	(max)	(min)
a. Acceleration	25G	2 G
b. Jolt	1000 G/SEC	100 G/SEC
c. Velocity	25.9 M/sec (85 ft/sec)	1.5M/sec (5 ft/sec)
d. Stroke	1.5 M (5 ft)	.05M (.17 ft)

e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine			
e.2. 1/2 Sine			
e.3. Triangle			
e.4. Trapezoidal			
e.5. Rectangle			
e.6. Sawtooth			
e.7. Other (indicate)			

f. Repeatability

f.1. Peak G ±5 %
f.2. Peak Velocity ±3 %

8. Instrumentation

a. Number of Channel — 25 (UP TO 14 ON MAGNETIC TAPE)
b. Frequency Response/Class — 1 KHz/1000
c. Method of recording
c.1. Tape — X
c.2. Chart — X
c.3. Other (specify)
d. Method of Transmission
d.1. Flying lead — X
d.2. FM Transmission
e. Accelerometers

e.1. Types	STRAIN GAGE		
e.2. Dynamic Range	±100 G		
e.3. Frequency Range	0 TO 750Hz		
e.4. Number	2		
e.4.a. on Sled	9		
e.4.b. on subject/dummy			

f. Other Parameters Monitored: PRESSURE, FORCE, DISPLACEMENT, HIGH SPEED PHOTOGRAPHY

NATO/AGARD

Impact Test Facility Survey

ID #45

1. Name and Address of Facility — SOUTHWEST RESEARCH INSTITUTE
   6220 CULEBRA ROAD
   P.O. DRAWER 28510
   SAN ANTONIO, TX 78284

2. Name of Director/Manager — GERALD D. DRISCOLL

3. Date Facility became operational — JANUARY 1972

4. Principle of Operation — REBOUND, BUNGEE CORDS

5. Main Use/Test Type — EVALUATION OF AUTOMOTIVE AIRBAG AND BELT TYPE RESTRAINT SYSTEMS
   a. Man Rated: yes X no ___

6. Descriptive Details
   a. Horizontal X — c. Vertical ___
   b. Track Length 11.9m — d. Tower Height ___

e. Sled Characteristics	Sled #1	Sled #2	Sled #3
e.1. Weight (max)	850 lbs		
e.2. Width (max)	4 ft		
e.3. Length (max)	6 ft		

f. Payload Characteristics	Sled #1	Sled #2	Sled #3
f.1. Weight (max)	4000 lbs		
f.2. Width (max)	~10 ft		
f.3. Length (max)	~12 ft		
f.4. Range of Orientation	0-360° yaw		

with an adjustable turntable

7. Performance Parameters
   a. Acceleration 60 g (max) ~.5 g (min usable)
   b. Jolt ~6000 g/s (max) ~50 g/s (min usable)
   c. Velocity 70 mph (max) ~1 mph (min usable)
   d. Stroke (Rebound Programmer) 19.75 in (max) ~.5 in (min usable)
   e. Waveform: (Check all that Apply)

		Range of Acceleration	Duration
e.1. Sine	X	.5-60 g	34-375 ms
e.2. 1/2 Sine	X	.5-60 g	34-375 ms
e.3. Triangle	X	.5-60 g	34-375 ms
e.4. Trapezoidal	X	.5-60 g	34-375 ms
e.5. Rectangle	X	.5-60 g	34-375 ms
e.6. Sawtooth		.5-60 g	37-400 ms

   e.7. Other (indicate) A VARIETY OF SYMMETRICAL BASICALLY GEOMETRICAL WAVEFORMS ARE POSSIBLE

   f. Repeatability
      f.1. Peak G 2 %
      f.2. Peak Velocity 4 %

8. Instrumentation
   a. Number of Channels 28
   b. Frequency Response/Class UP TO 5 KHz-SELECTIVE ANALOG FILTERING IS ACCOMPLISHED AS DATA IS TAKEN OFF ANALOG TAPE RECORDERS
   c. Method of recording
      c.1. Tape ANALOG AND DIGITAL RECORDERS
      c.2. Chart LIGHT BEAM OSCILLOGRAPH
      c.3. Other (specify) ___
   d. Method of Transmission
      d.1. Flying lead X (UMBILICAL TO SLED)
      d.2. FM Transmission ___
   e. Accelerometers - ENDEVCO PIEZORESISTIVE

e.1. Types	2264-2000	7264-2000	2260-250
e.2. Dynamic Range	-2000-2000G	-2000-2000G	-2500-250G
e.3. Frequency Range	0-5 KHz	0-5 KHz	0-2 KHz
e.4. Number			
e.4.a. on sled	2		
e.4.b. on subject/dummy	UP TO 24		

   f. Other Parameters Monitored: TYPICALLY: SLED VELOCITY; RESTRAINT SYSTEM LOADS, PRESSURES, STRAIN; DUMMY FEMUR LOADS, LIVE SUBJECT ECG AND BLOOD PRESSURE; AND TIMES OF SPECIFIED EVENTS.

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14. Abstract

The author has up-dated AGARD Report No.658 "A Catalogue of Current Impact Devices" to include new/revised facilities, has presented research procedures in use at each facility and described the personnel capabilities available. The information about each facility has been obtained largely from inputs completed by the establishments concerned, technical reports, previous listings and personal visits.

This AGARDograph will be useful to programme managers and scientists of the aerospace medical and biodynamic community who wish to be aware of test facilities currently in use at NATO research establishments.

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Advisory Group for Aerospace Research and Development, NATO
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